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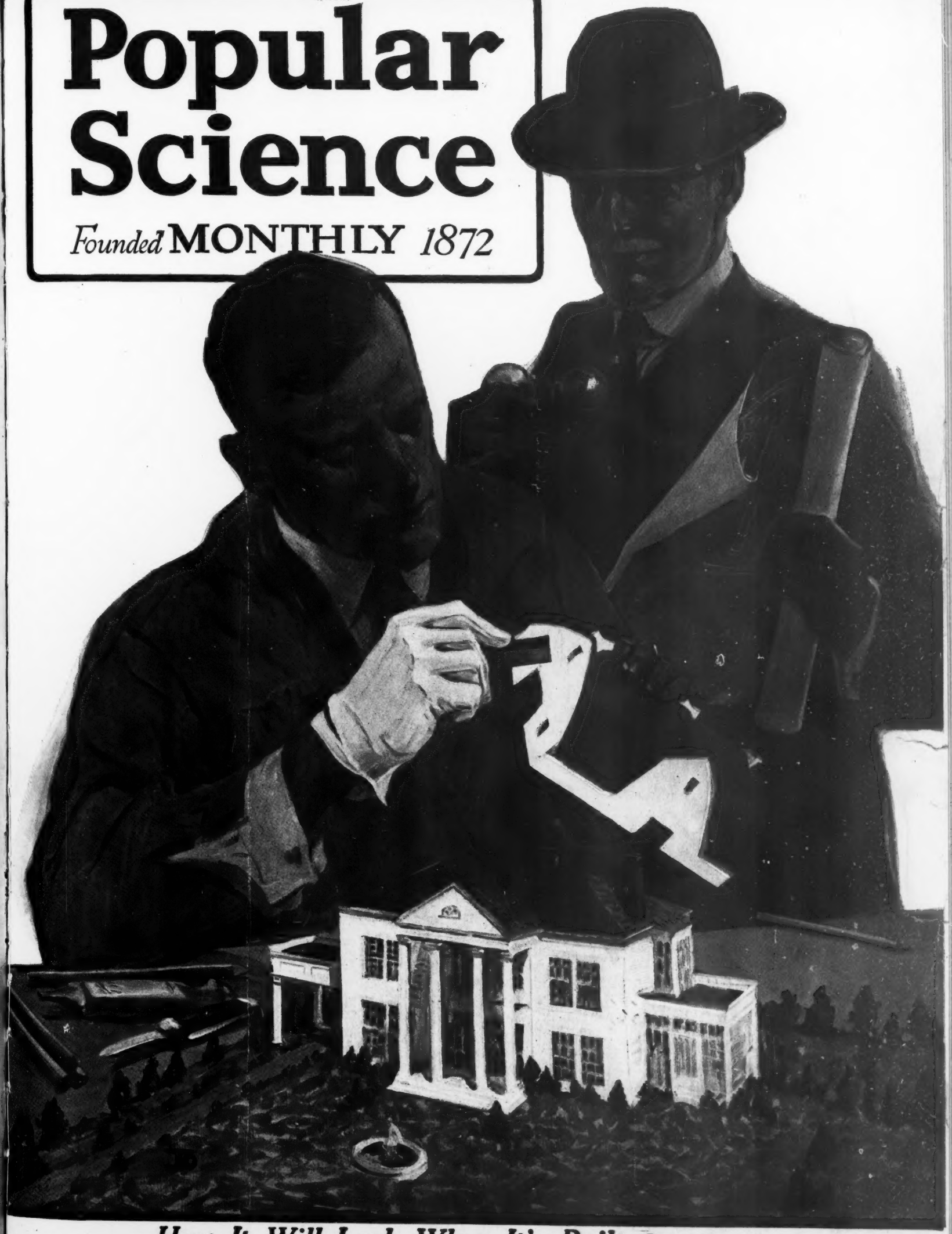

***How It Will Look When It's Built*—See page 72**

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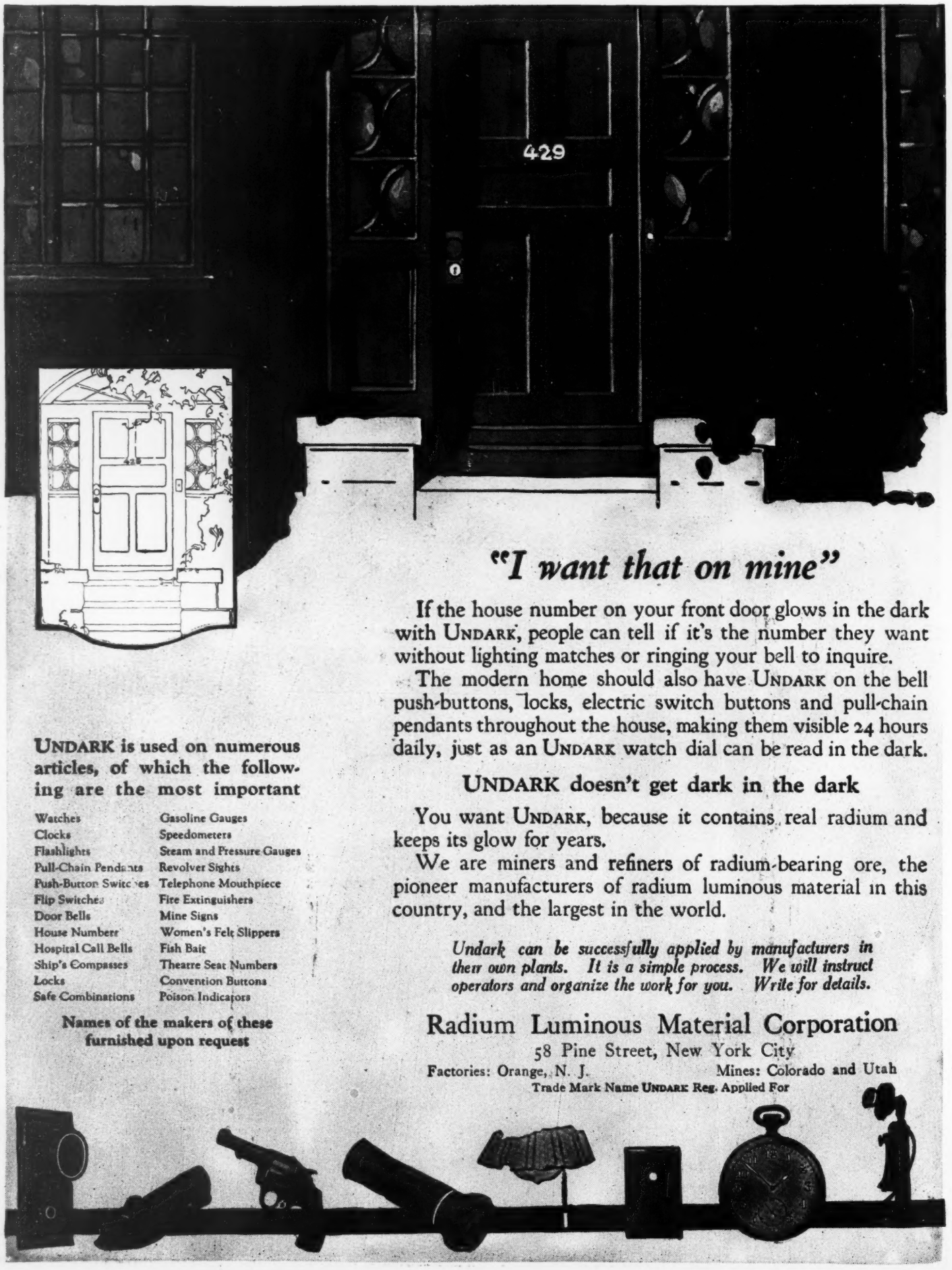

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IV Song of the Shepherd Lehl — Rimsky-Korsakow
Alma Gluck
V Symphony in F Minor, No. 4 — Tschaikowsky
Boston Symphony Orchestra
Program
VI Don Giovanni—Il mio tesoro — Mozart
John McCormack
VII But the Lord is Mindful of His Own — Mendelssohn
Ernestine Shumann-Heink
VIII Pagliacci—Vesti la giubba — Leoncavallo
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Popular Science Monthly

SEPT., 1920

Volume 97-No. 3

CONTENTS

AERONAUTICS

Using the Airplane Crankshaft as a Gun..... 39
Water-Wings for the Airplane..... 55
Airplanes by Wholesale or Retail..... 59
Guns that Shoot Colored Fire..... 74
"Smeltery Not Guilty," Says the Airplane..... 75

HOUSEKEEPING MADE EASY

Every Man Can Be His Own Cobbler..... 43
Find Out What Size Shoe You Wear..... 45
Here's a New Way to Clean a Pipe..... 45
How to Shave by Reflected Light..... 47
Making Hard Water Behave..... 50
Making a Boiler into a Pedestal..... 52
The Smallest Phonograph..... 53
Here's a Place for the Magazines..... 55
A Vase that Swallows Smoke..... 55
For Conveniently Tilting Heavy Cans..... 56
Purify Dirty Pipes with Steam..... 57
'Twas a Hot Night in Summer..... 66
If the Cost of Ice Continues to Rise..... 68
The Swatter that Kills and Swallows Them... 77
Swatting by Vacuum Cleaner..... 77
Combined Dining-Table and Pantry..... 84

INDUSTRIAL PROGRESS

Machines to Make Men Safe for Democracy.. 21
This Apparatus Will Weigh Your Signature... 38
Stone-Jointing Taught by Lantern-Slides..... 40
Army Boots to Be Made Over for Civilians..... 42
How the Chinese Dry Their Spaghetti..... 42
A 2000-Year-Old Idea Changed..... 44

(Continued on page 4)

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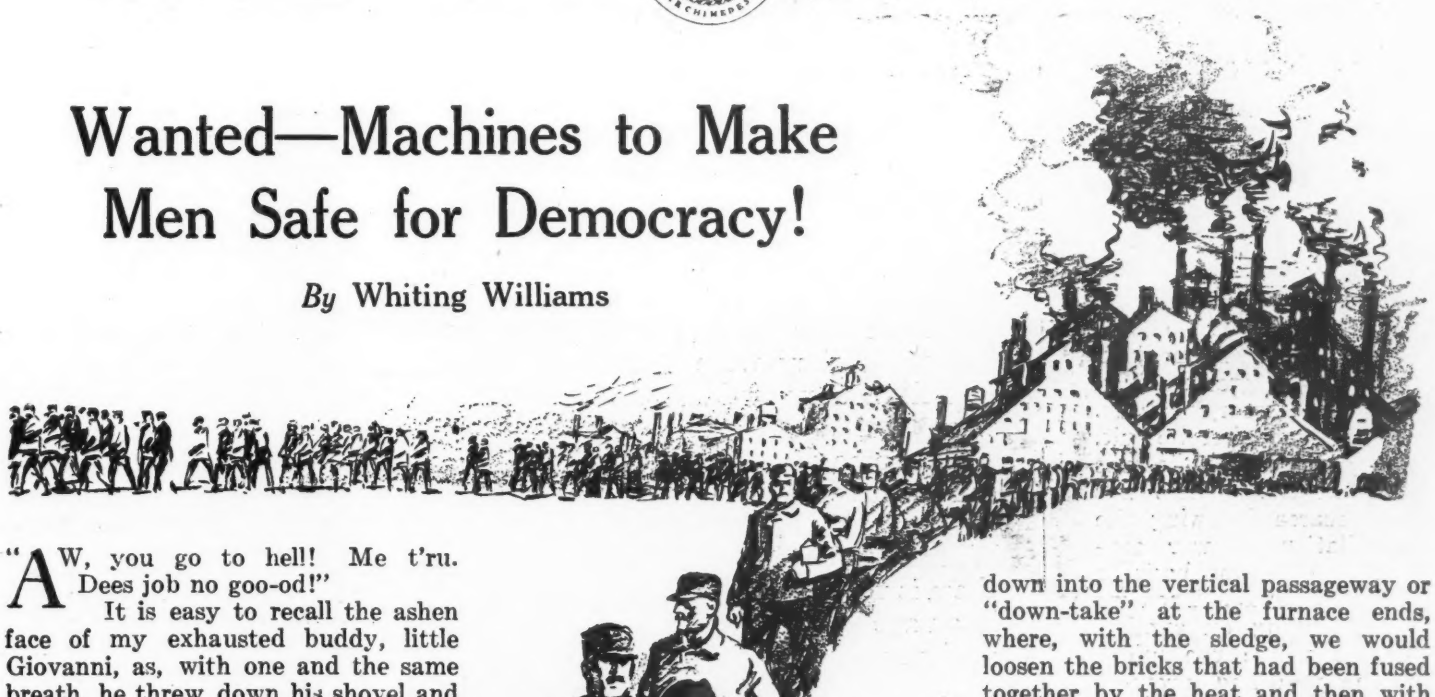
Wanted—Machines to Make Men Safe for Democracy!

By Whiting Williams



"AW, you go to hell! Me t'ru. Dees job no goo-od!"

It is easy to recall the ashen face of my exhausted buddy, little Giovanni, as, with one and the same breath, he threw down his shovel and his defiance to the boss in charge of the gang of us removing the bricks from the caved-in open-hearth furnace, that first night of my months in search of the causes of industrial unrest.

It is easy, and very significant, to recall, too, that it was in the near-dawn moments of the long night-shift—the moments that stepped upon the weary heels of the ninth and tenth hours of hard, hot, dirty, brainless, brawny, arm-and-shoulder-muscle labor.

Moving bricks and bats, bricks and bats, more bricks and more bats; that was the job—the whole job. Good bricks we carried, three or four at a time, a distance of twenty or thirty feet, and piled back of the next furnace, handy for the masons when they should follow us for the rebuilding of the new walls and roof upon the foundations we were uncovering. Bad ones or "bats" we picked up in hand or shovel, and after carrying them to the rail at the edge of the open-hearth floor or platform, tossed them into the great boxes standing open-topped in the cinder-pit, from where they could be picked up like mere waste-baskets by the huge cranes, and whisked over for emptying into the flat-cars bound for the dump.

Every so often Giovanni and the rest of us would take our turn getting down into the vertical passageway or "down-take" at the furnace ends, where, with the sledge, we would loosen the bricks that had been fused together by the heat and then with our shovels lift them, still hot, up to the platform for the others to dispose of. And always the lift grew greater and always the bricks grew hotter as we got further down into the substructure. And always the dust from the draft grew worse and the scorching breath from below harder to bear.

The author in disguise, looking for work. He is carrying his worldly goods under his arm. He is "on his way": he *must* find work, at once

When Stephanos, the Greek, fainted, and so had to be relieved from taking his turn, the turn of the rest of us, of course, came that much oftener. As the night wore on, the boss would doze as he sat on the pile to watch us, and then would waken angrily to question our reckoning of the moments we had spent in the hot hole that gave us the right to "catch spell" above, while another took our place below.

The Stage Set for Trouble

It was after Giovanni and the rest of us—dripping wet—had been taken out of that and led into the winter's rain of the yard to carry the back-breaking weight of the steel roof-beams required for the rebuilding of the furnace, and then, after much swearing and grunting and many urgings of "Watch yourself! Watch yourself!" had been led back to the bricks again—it was after that, that the boy's face began to show pale through its grime. Then the stage

was set for trouble—trouble that was bound to come when the slightest imaginable thing went wrong, as when some brick would add the straw's weight to the camel's back of his exhausted self-control by refusing to come properly on to the shovel, or when the boss, himself wearied by the long turns, would make some too pointed remark.

Hours Like Years

"T'ree mont' shovel damn breeck—alla time shovel damn breeck—alla time, night and day, t'ree mont'. Twelf'-hour night, ten-hour day, twelf'-hour night, ten-hour day—alla time damn breeck," Giovanni had explained an hour or two before the final break came, as I felt him out to learn why I seemed, in spite of my greenness on the job, less weary than he.

But, even after he quit, he turned up again, because work in the district was very scarce following the cancellation of war contracts. This was back in February, 1919. Then we were working on another furnace where the bricks of the roof had dropped down into the hot "bath" of metal. From there we had to loosen them with bar and sledge and shovel from where we stood on planks —with pails of water handy for use when these caught fire beneath our feet!

Even with a half-hour "spell" after every half hour on the planks, all of us found the near-morning hours as long as weary, sweaty years; especially after the boss failed to show the leadership necessary to keep a few from doing most of the work of carrying those dreadful iron roof-beams into place: the backs of even a score of strong men do not suffice to make the long beams ight if those backs do not bring their strength to bear in that unison of effort which comes only from the direction of a good leader.

After the bricks were loosened and tossed to one side, then came again, of course, those long hours of carrying to the piles and of tossing and shoveling into the boxes in the cinderpit, with, every so often, the turn of sledging and lifting them up to the floor from the dusty, scorching nostrils of the down-takes. Hour after hour of it.

Then the next night would, perhaps, find the gang in the checker-chambers —those expanded chimneys, the size of ordinary dining-rooms, in which the bricks are laid checker-wise in order to catch the heat of the draft as it rushes out on its way to the stack after it has breathed its gassy fury on the "bath" of metal and has passed through the down-take into the chambers. It is by the half-hourly reversing of the direction of this draft that the regenerating furnace keeps growing hotter till the carbon of the bath of scrap and pig, etc., is brought to the proper percentage.

Beginning at the chamber's bottom, twenty feet beneath the level of the opening, the gang would station itself in steps for tossing the heavy brick till they emerged and found them piled high ready for re-use.

Once in a while bad ones would break in midair, their heavier part landing on some unfortunate's toe.

Bricks, heavy bricks—about the weight of five ordinary bricks—soot and sweat and dust and profanity—of these the checker-chamber is the perennial abode.

Life Absolutely Impossible

When, under the demand for more steel, only an indecent amount of time has been given for the cooling of the chambers, the schedule is made for working twenty minutes in and resting twenty minutes out. But the cool passageway often proves too attractive for the dripping men to favor anything better than five in and twenty out.

Our plant doctor reported that his thermometers had shown a heat in the "checkers" which is known to make life absolutely impossible.

That job rendered comfortable and attractive by comparison the work that Giovanni and I did when we happened to be assigned to shoveling out the "cinder" from the bottom of one of those down-takes. With his air-drill put-put-puttering like a machine-gun, and biting and scolding and leaping at the amazingly hard and heavy droppings of the draft, the man above us would try to break out the pieces and roll them down to our shovels. A few feet of a throw in the direction of the box was the best we could do. Having done that, we could only go over to the pile thus made, and then take another throw and another, until finally the box, placed

Employer or Worker, This Article Is for You

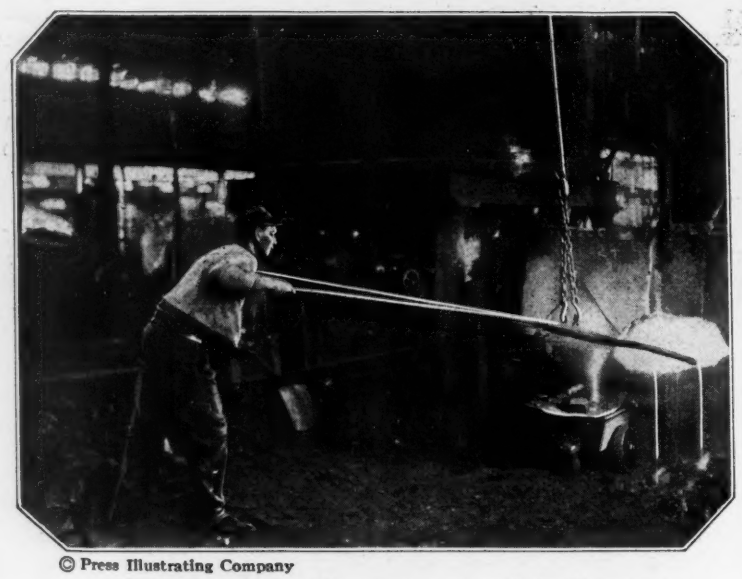
"I'll find out for myself what all this labor unrest is about," said Whiting Williams, of the Cleveland Hydraulic Pressed Steel Company.

And so he put on overalls and a corduroy jacket and worked as a common laborer in steel plants, coal-mines, shipyards, roundhouses, and mills.

He mingled with Hungarians, Poles, Slovaks, the horde of unassimilated foreigners who do most of the back-breaking work of the mines and mills. They told him why they were restless—told him as well as they could in their inarticulate way.

But some things they could not tell, because these things go to the very root of human feeling. It needs a man of Williams' training to tell them. One of them is the frightful wastage of humanity in an age that prides itself on its technical achievements.

Read this article which we have asked Mr. Williams to write for us.—EDITOR.



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The heat in places where men must work is often so intense that, according to the thermometer, life is impossible. Yet men are found to work in them

Whiting Williams, the Man Who Studied Labor Problems at First Hand

Whiting Williams has long been studying the problems arising out of the social progress of America. His eight years as assistant to the president of Oberlin College, with chief responsibility for its outside relations, were followed by four as secretary of the country's first large federation of a city's welfare agency as founded in Cleveland by the Chamber of Commerce.

Later he entered industry, and became responsible for the relations of a steel company with its 4000 employees. Williams decided to get a job as a laborer and learn at first hand what caused the unrest he observed all around him. He spent most of 1919 disguised. While he worked, he watched and listened; and because, as he listened, he was going through it all, he understood.

When you have read his article, look around in your own factory, especially if you are an employer, and see whether machines can't do some of the work that is now wastefully and oppressively done by human muscles.

Mr. Williams tells how machines make better citizens by winding up the mainspring of men's self-respect.

perhaps high upon an unobliging pile of ashes or "bats," came within the reach of an extra long, high swing. Toward morning our heads would be throbbing with the everlasting bang-banging of the drill, and our aching wrists and forearms would be counseling the lifting by hand of the larger pieces for carrying them bodily to that distant box—and later, perhaps, kicking and rolling them when fingers and thumbs joined wrists and forearms in hoisting the strike signals of weary pain.

After a night of that a worker would find himself wanting fairly to scream a fearful curse when he beheld the great crane come along and, without the slightest visible or audible effort, jauntily swing that boxful of his aching wrists and forearms and pounding head up aloft, and in an instant have it over to the car and emptied!

In the Name of Giovanni

Why could not that box have been swung in under the platform nearer to the down-take and, with a cable arranged like the "crab" or winder which whisks the loaded cars out of the "rooms" in the coal-mines, have been swung out again, when full, to where the hoist could do its easy trick! Or why could not the box be placed more often, as it sometimes is, inside the down-take for pulling out when full of cinder? Or why could not the pit-side wall of the down-take be taken down and the whole mass of cinder yanked out and over into the car? Or why—well, mine is not the engineering skill for asking such questions.

But, in the name of the backs and the forearms of the thousands of Giovannis, I do feel it imperative to send an S. O. S. to the engineers for more attention to the saving of the muscles of the labor gang.

Shovels, when used efficiently, are wonderful. Nevertheless, it is my firm opinion that no democracy is either as safe or as forward-moving as it should be when the bottom of its industrial pyramid rests upon a great body of citizens of whom no greater demand is ever made than that of shoveling—badly directed and, for the most part, very ineffective shoveling.

In steel to-day the great need is for a shorter work-day—in order to get happier citizens and aliens who will thereby be enabled to think well of themselves, their families, and their adopted land.

And in steel to-day the number of men whose arms and shoulders are needed at the shovel and in the checker-chambers is serving to postpone the coming of that shorter day by raising the question as to where the additional workers could be found for the extra shift.

Meanwhile, in thousands of plants and at thousands of coal-yards all over the country, laborers are contributing to the same shortage by getting coal and similar materials out of railway cars by the use of nothing but human arm-and-back power. Meanwhile, too, cranes and manifold other machines waste power wantonly inside of those same plants, while employment managers worry themselves to death because they can't succeed in filling the production manager's insistent requisitions for "common

Mr. Williams, who is shown here as a laborer, says: "In the name of the backs of thousands of workers in mines and factories, I feel it imperative to send an S. O. S. to the engineers of the country"

labor—more common labor: you've got to find us more common labor."

Meanwhile, too, the common labor that is being used is in many cases being directed by a sub-boss who has the drive and the superheated language necessary to keep his labor moving, even though he gets only a small percentage of the gang's actual M. P. U's (man-power units), but who lacks completely the head with which to make the M. P. U's he does get count for anything like the proper number of C. W. D's (company work done). In all probability, that will always be true, because intelligent men will probably never be hirable at a practicable price for the work of directing the efforts of men and citizens whose only capital is unthinking brawn. Still further, neither boss nor man is capable of exhibiting or responding to intelligent leadership if he has to be on the job an average of nearly twelve hours for fourteen turns every fourteen days, as do the labor gangs of most big steel plants.

Hearts Brought Down with Labor

But the worst thing about brawn and the reason for the serious danger of a social, industrial, and political pyramid which rests upon brawn, is not so much that brawn is unthinking as that *brawn is never unfeeling;* that the less brawn thinks, the more it feels—and the more tired it is, the more dangerous is its feeling to the general good.

Without the safeguard of thinking, men are absolutely at the disposal of those who will take the trouble to learn how to drive them—for the country's good or the country's ill. And we are to blame for their misdoings if we do not see that it is the shovel which pats them down into that unthinking and much-feeling mass which is then certain to proceed to sag with the weight of the pyramid above it at just the time when the rest of the pyramid is praying for stability.

Then, too, the man of the shovel or the bar, or the man who only tends the switch or drives the spike into the railway tie, is bound to move about like quicksand there at the bottom of that pyramid. His lack of skill, his poverty of "know-how," makes one job just as attractive to him as another, as long as its demands are equally contemptuous of skill and equally insistent upon mere muscle.

"We engineers strike? Well, I guess not! Why, where would *we* be if we didn't win? But them switchmen and trackmen—sure, why shouldn't they strike! *They* can get their kind of a job anywheres."

"No, I wouldn't give a 'white man' like you a job here on our hand-charged blast-furnaces. Lord knows, we have enough trouble to hold the lowest kind of foreign-born labor—and they're mostly drunken at that. You might give us a look-in in the fall, when we'll have the new machinery."

This was the word of a superintendent when, one day, looking as tough as I could, I told my tale of woe and asked if "they wasn't a chance fer a man's gettin' on around there somewhures."

Work that No Man Covets

"Sure, all these fellers has had a go at them bum jobs—or has heard about 'em from their friends." So a young chap assured me one evening when I asked him why the seventy-five applicants for work at a big Western steel plant's "bull-pen" kept silent while the employment manager went among the crowd saying, "Anybody here want to go on for open-hearth number two?—or coke plant?—or rail-mill?"

"And them as do go on tonight will be out here tomorrow night fer somethin' else," the man went on. "Why, look at them hands! Them's from eleven hours steady—'thout no spell—on one of them jobs. Don't they look as though I ought to try somethin' else, huh?"

They certainly did.

"Alla time lift 'em up rail, push 'em up rail, carry 'em over rail—no goo-od!"

broke in a Polish man who also was out to take a try at some of the other white slips the employment man had in his hand.

The Laborer-Floater

One of the great brakes upon production to-day is the mass of men who float or "tourist" from one job to another. Most of them are "common labor." Here today, there tomorrow, their motto could be given as that reported for the patrons of a certain famous and fast-moving travel agency: "Anywhere but here!"

More labor-saving machinery must be used both to lessen the present shortage of even such workers—or near-workers—as these, and also to permit those that do get on to the job to stay without losing their self-respect. For these men do have self-respect—every worker knows that he gets his standing among other workers according to the nature of his job.

By as much as the winning of the war made the world safe for democracy and increased the ordinary man's right to think well of himself, by so much must machinery make unnecessary the old line of jobs which made a man careless and hopeless because they "rubbed it in" to his soul that he was at the hot, dirty, smoky, or muddy bottom of the whole industrial organization and had no right to take himself seriously as a producer. Give the same man a machine, teach him some skill in the use of it, and he will take your breath away by the speed with which he will proceed to lord it over the "cheap guys" who continue to do the work of a "wop." Incidentally, he will stay a lot longer on the job, because he knows that if he can't use his newly acquired skill at the other place, then the taking of it will cost him his standing—his "face"—among his friends. All the while, too, of course, he will be counting to lessen the world's shortage of goods infinitely more than before when he worked only with his untrained hands.

When, however, the worker who has grown to that high estate in the plant peerage where he carries tools instead of shovels and sledges, his eagerness for producing a maximum of goods may be dulled by the millwright department. If he is asked to keep using tools or machines that he and everybody else knows are worthless, or if the company refuses to hire enough men to keep his tongs in good shape without long delay, or if the power of the rolls and the time of four men has to be wasted because he can't get a guide to keep his pile of steel sheets from falling down—well, in that case he is likely to say to himself and his buddies:

"Say, where do they get this stuff about *we* should get 'more production,' huh?"

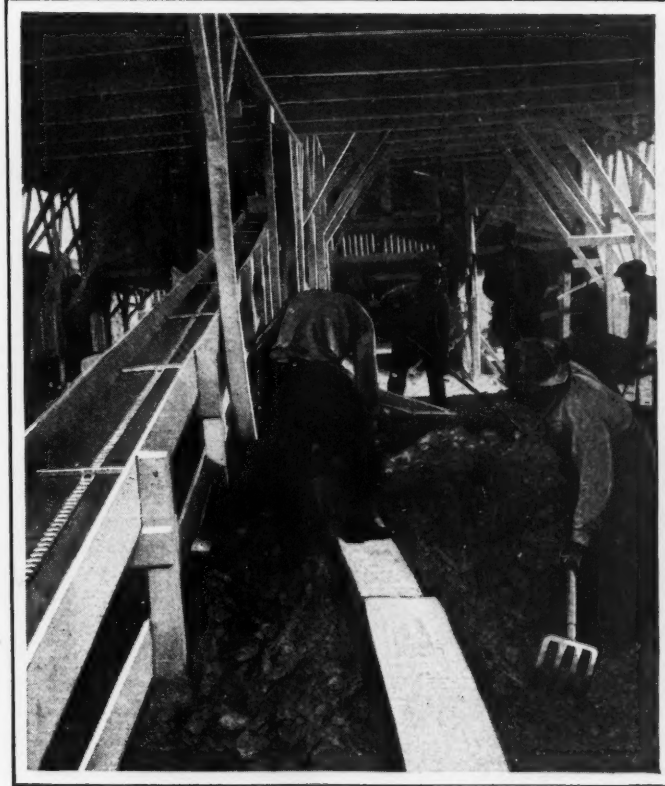
"We often contrive machines that we figure will save a lot of men and sweat and money. Then we send the plans down to the head office and ask for their O. K.—and the coin," a local "super" explained one day recently. "The next thing is, likely enough, a letter from the 'G. M.' saying that our labor costs and our ingot-ton costs are already as low as anybody's and why spend money! Now, what can a fellow do then?"

I wonder if the "G. M." has ever felt that such a letter as that should make him keep silent at least a month from all his daily complaints about both labor shortage and industrial unrest.

If it is objected that unskilled labor often fights the introduction of machinery, it can at least be answered that there never was a better time for introducing new tools than right now, when the workers themselves are so hard to find.

Machinery Aids Men's Self-Respect

In steel, particularly, so much machinery has been already introduced that it seems ungrateful to urge the necessity of going farther. It is true that the number of tons to a man has been greatly increased within recent years, especially in the rolling-mills. But, with such good results already obtained, the effort should be pushed all the more. In my opinion, steel will never know anything like peace until it knows a shorter workday than the twelve, fourteen, eighteen, and twenty-four hour turns it knows too well at present. And that day will be speeded when all the country's plants and yards of every kind begin to be ashamed to let men move coal and bricks and bats and similar materials by hand.



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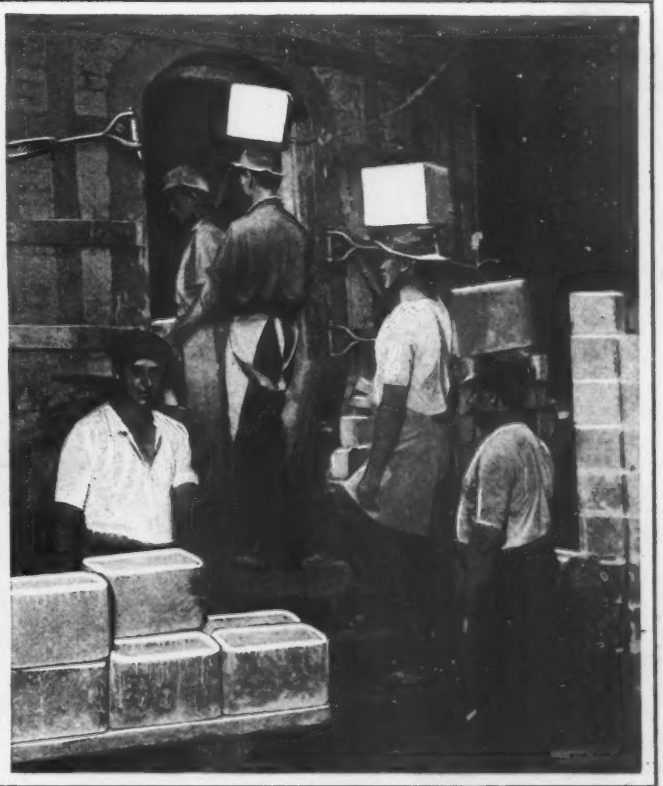
Mr. Williams believes that no democracy is safe whose industrial pyramid rests on a body of citizens of whom no more is demanded than to shovel



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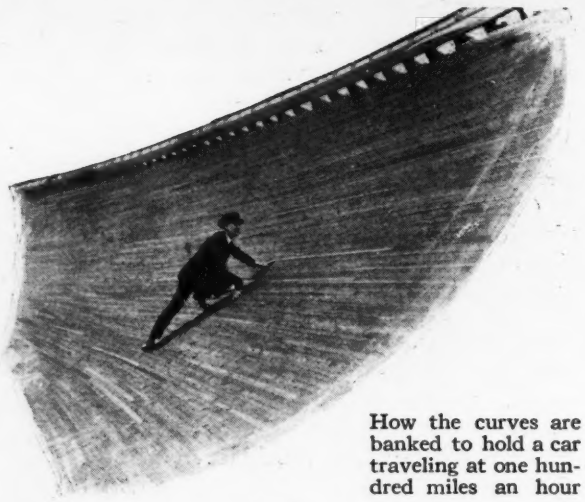
Must this kind of labor be done in so archaic a fashion? Surely machinery could do this work and release these men for something better

The Sport of Plutocrats

The new million-dollar automobile speedway at Los Angeles is the greatest track-building feat

By Fred Gilman Jopp



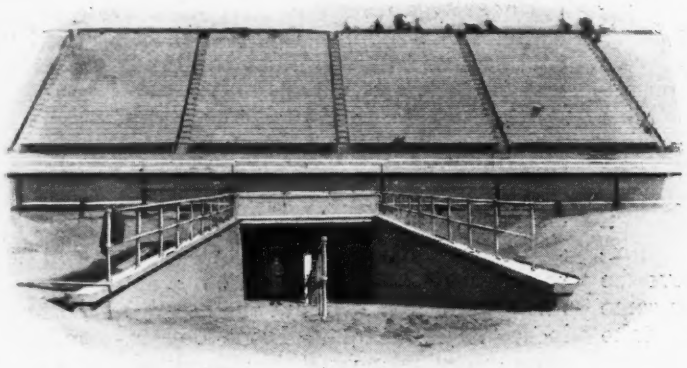
How the curves are banked to hold a car traveling at one hundred miles an hour

RED-BLOODED men have always been interested in contests of speed, stamina, and endurance. Yet most of us have taken as a matter of course the remarkable strides that have marked automobile improvement from the one-cylinder vehicle of only two decades ago to the long, low, rakish, and comfortable high-powered car of today. A large part of this development must be credited to lessons learned on the automobile speedway.

Hundreds of thousands of people attend the automobile races and enjoy the thrills of the speedway. To those who have studied the sport it is apparent that racing has a deeper and more important significance than appears on the surface. It is from the lessons learned on the race-track that manufacturers have been enabled to better their production of automobiles. The engines, the accessory parts, and the tires, all have been improved through lessons the track has taught.

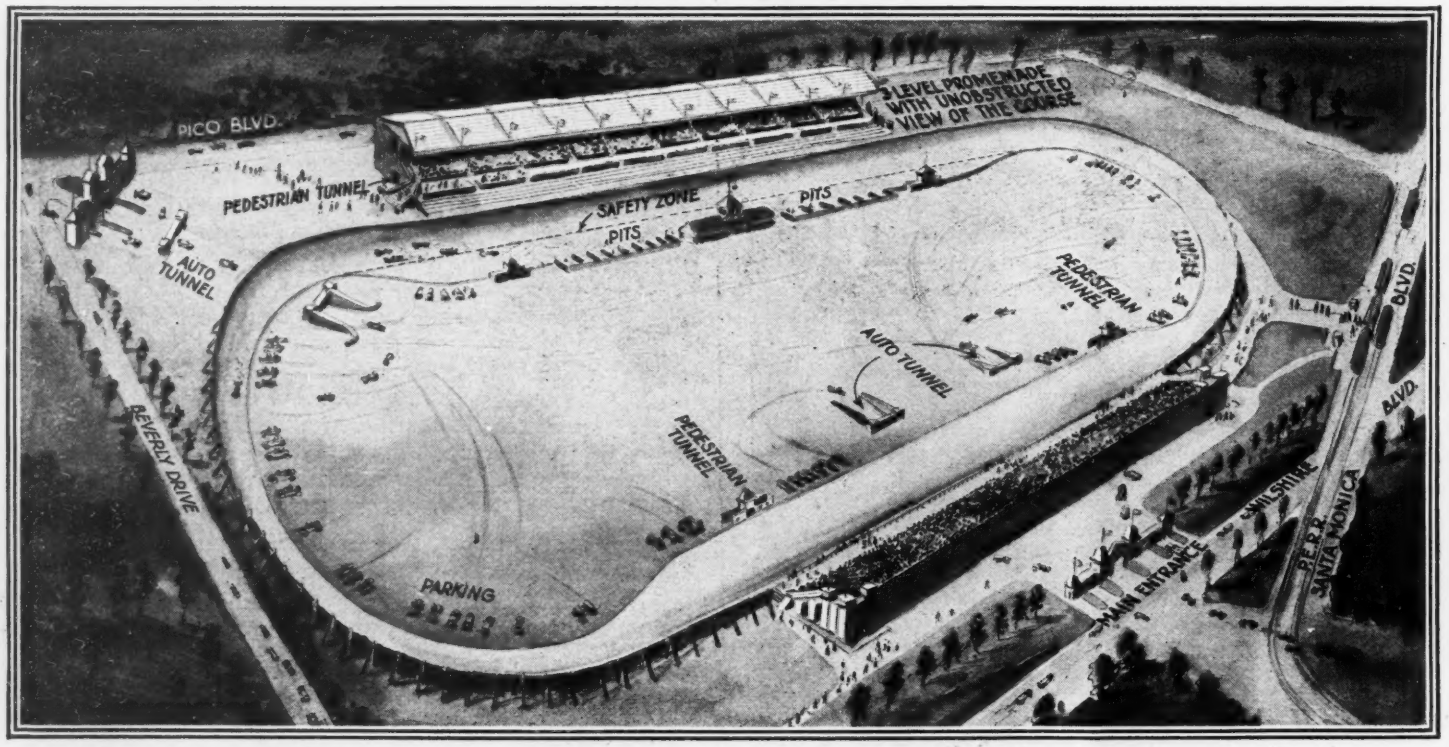
The new Los Angeles million-dollar motor speedway, recently completed, is one of the most astounding track-building feats in the history of racing. More than 4,000,000 feet of lumber went into its construction and exactly one hundred working days lapsed between the driving of the first and last spikes.

The track contains features heretofore never built into a race-course. From a dead level on the straightaways it gradually, almost imperceptibly, inclines to a bank which at the apex of the turns has a slant of thirty-five degrees, requiring a speed of approximately one hundred miles per hour to hold the car upon them. The surface is constructed of two-by-fours set edgewise, which affords a cordlike, skidless track on which the smoothest tire will hold under almost any strain. The safety zone has the unusual width of fifty feet.

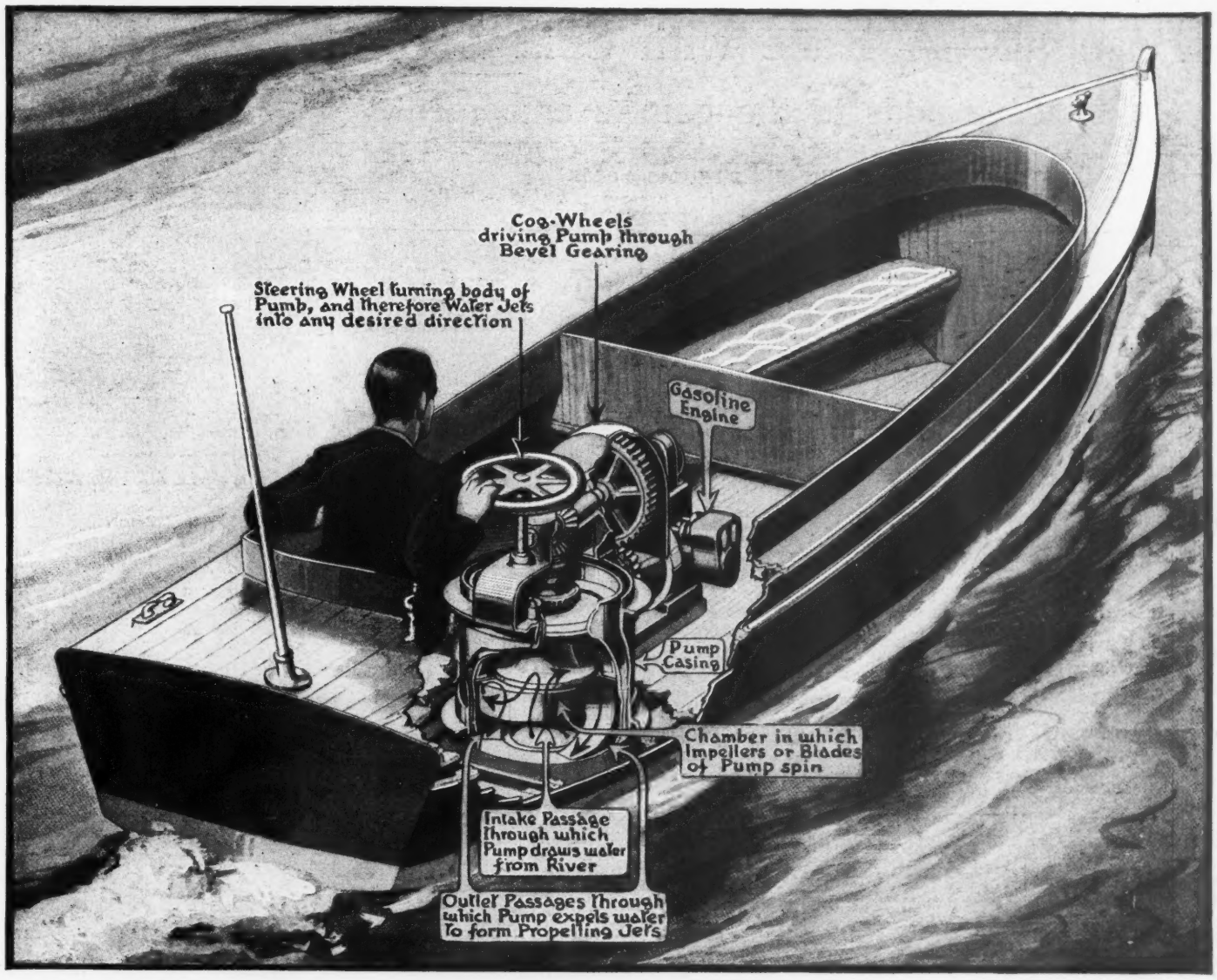


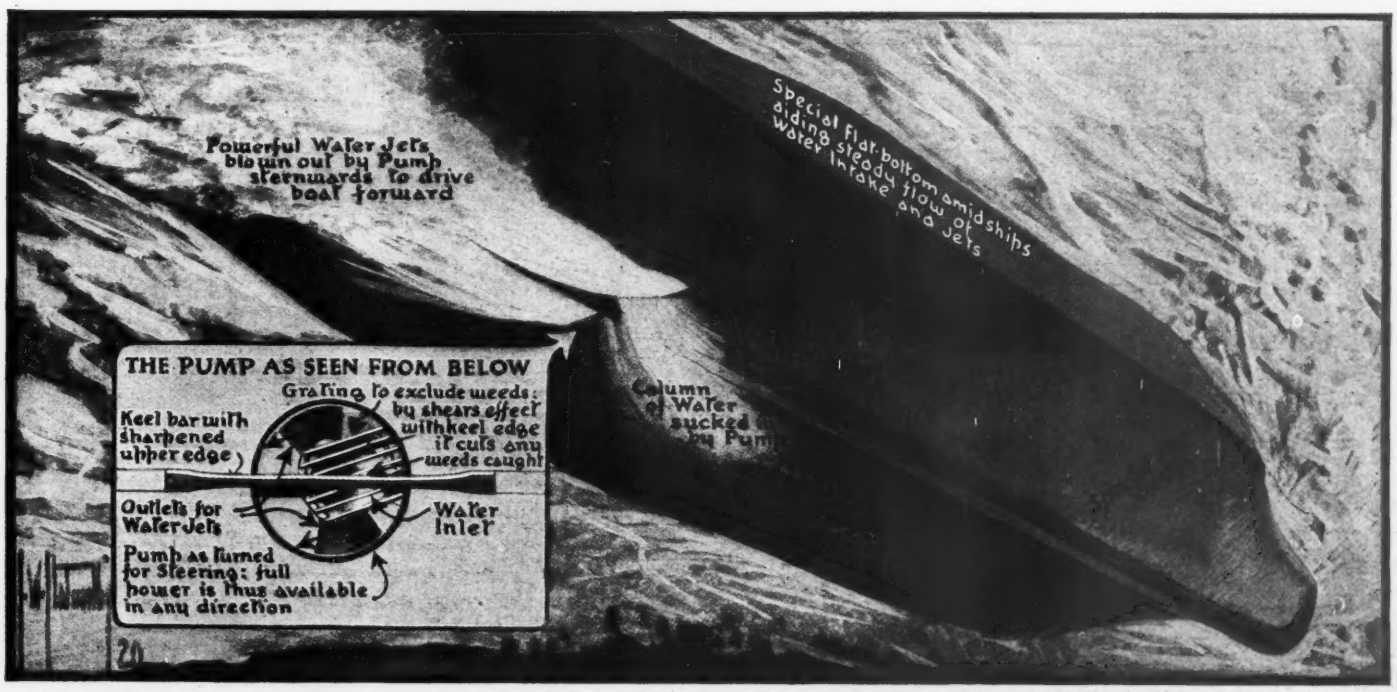
One of the three automobile tunnels under the grandstand and the track

Striking, too, is the provision for handling the multitude of spectators who will patronize the races. Three twin-bore automobile tunnels run beneath the track to the extensive infield. There are also two other tunnels for pedestrians. Parking space is provided for 11,000 automobiles, 4,000 in the infield and 7,000 in enclosures outside of the oval. Two immense grandstands will accommodate 30,000 people. 200 acres are covered.



In the 250-mile race on the opening day, Jimmy Murphy (an unknown) covered the entire distance at an average speed of 103.2 miles per hour. There were eighteen starters, and the fact that there were no fatalities constituted a strong argument for the safety and efficiency of the new course


Cog-Wheels driving Pump through Bevel Gearing
Steering Wheel turning body of Pump, and therefore Water Jets into any desired direction
Gasoline Engine
Pump Casing
Chamber in which Impellers or Blades of Pump spin
Intake Passage through which Pump draws water from River
Outlet Passages through which Pump expels water to form Propelling Jets


Powerful Water Jets blown out by Pump sternwards to drive boat forward
Special Flat-bottom amidships aiding steady flow of Water Intake and Jets
THE PUMP AS SEEN FROM BELOW
Grating to exclude weeds: by shears effect with keel edge it cuts any weeds caught
Keel bar with sharpened upper edge
Outlets for Water Jets
Water Inlet
Pump as turned for Steering: full power is thus available in any direction
20

A Rudderless Boat Propelled by a Pump

HERE is a boat that is kicked along on the principle of a sky-rocket. Instead of a propeller, an air-screw, or a paddle, this boat is provided with a pump, which sucks in a volume of water and expels it underneath the boat.

Water jets pass through the opening, circulate inside the easing of the pump, and are forcefully expelled sternward.

The rotation of the blades of the pump which draws in the water and expels it, is imparted by a gasoline engine. One advantage of this method of driving a boat is that the rudder is eliminated. The pump turns any way, causing the jets of water to enter and be blown out in various directions, guiding the boat wherever desired

Baseball—A Race with Split Seconds

Science adds to the game's enjoyment

By Raymond Francis Yates

Take This with You in the Grand-Stand

The next time you go to a ball game, tuck this article away in your coat pocket, take a good stop-watch, and when you get there, use both of them. Begin to educate yourself in the scientific fundamentals of the game. You don't have to be a mathematician to apply scientific reasoning to baseball problems

WHANG! Babe Ruth bangs out a fast grounder. As the left fielder picks it up and throws it 240 feet to first base at a speed of 90 miles an hour, Ruth is just half way to his destination, traveling at the rate of 100 yards in 11 seconds. Will he be out or safe?

A lightning calculator could figure out to within a few hundredths, or possibly thousandths, of a second whether or not Ruth would be safe long before the umpire could render a decision. The spectators yell excitedly while the lightning calculator sits back in his seat and says to himself: "Ruth will be safe, with half a second to spare."

Any one with sufficient interest in the game and the inclination to spend a few minutes in acquainting himself with certain fundamentals will be able to do just what a lightning calculator could do without any calculation—by trained judgment. The only thing that tempers judgment in baseball is mathematics.

The mathematics and geometry of baseball are extremely fascinating. And you don't have to be either a mathematician or a geometrician to apply scientific reasoning to the problems of the home team.

Euclid and Baseball

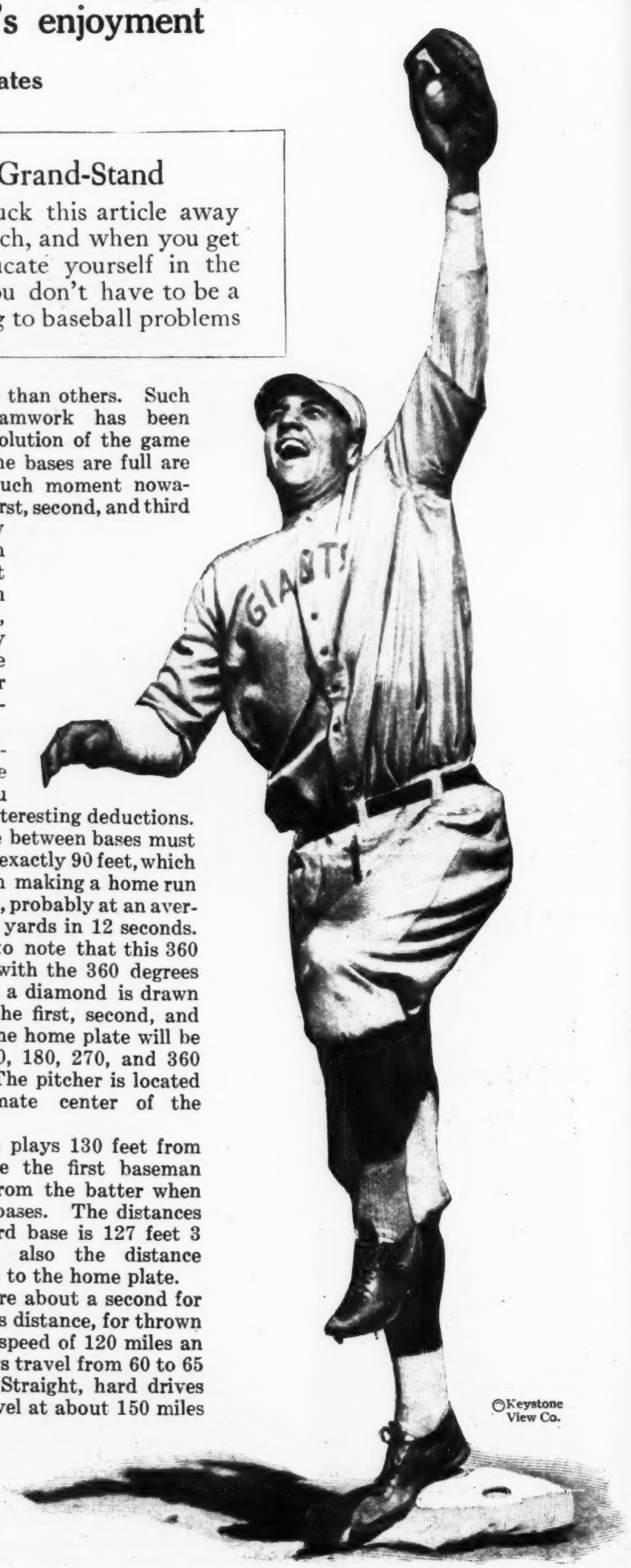
Euclid had a lot to do with baseball, although he lived many hundred years ago. Fortunately for most of us, however, we do not have to concern ourselves with the axioms, theorems, quadrilaterals, or trapeziums of modern Euclidian geometry. We can reduce the whole matter to those simple calculations that still linger with us—salvage from our schooldays.

Every baseball fan worthy of the name will recognize the meaning of the shaded portions of the ball diamond shown on page 29. These are known as the "grooves" in baseball parlance. They are the most difficult parts of the ground to "cover" properly. Balls landing within the grooves are more apt to be safe hits than others. Such perfection in teamwork has been reached in the evolution of the game that only when the bases are full are the grooves of much moment nowadays. Hence the first, second, and third baseman are partly eliminated from taking active part in the protection of the weak spots, and it is physically impossible for the fieldmen to cover the complete territory thoroughly.

Use the diagram showing the grooves and you can make some interesting deductions. First, the distance between bases must be known. This is exactly 90 feet, which means that a man making a home run will cover 360 feet, probably at an average speed of 100 yards in 12 seconds. It is interesting to note that this 360 feet corresponds with the 360 degrees of the circle. If a diamond is drawn within a circle, the first, second, and third base, and the home plate will be located at the 90, 180, 270, and 360 degree marks. The pitcher is located at the approximate center of the circle.

The short-stop plays 130 feet from the batter, while the first baseman plays 103 feet from the batter when men are on the bases. The distances from first to third base is 127 feet 3 inches. This is also the distance from second base to the home plate.

It would require about a second for a ball to cover this distance, for thrown balls travel at a speed of 120 miles an hour. Grounders travel from 60 to 65 miles an hour. Straight, hard drives from the bat travel at about 150 miles



George Kelly, of the Giants, can reach nine feet without leaving the ground. A factor in baseball mathematics

an hour. There seem to be practically no data on the speed of "fly" balls. The speed in this case would depend partly upon the height the ball reached. The average time a runner takes between bases is 3½ seconds.

By means of the high-speed motion-picture camera many very accurate figures have been made available for the mathematical study of the game. The standard motion-picture camera takes pictures at the rate of sixteen a second. The high-speed camera takes pictures at the rate of one hundred and twenty pictures a second.

By knowing the number of pictures taken a second the exact time required for the players to make certain movements or the ball to travel certain distances can be determined.

A race between a thrown ball and a man. The ball is traveling about 135 miles an hour, the man 20 miles an hour. A rapid calculation will show that the man will not make the base

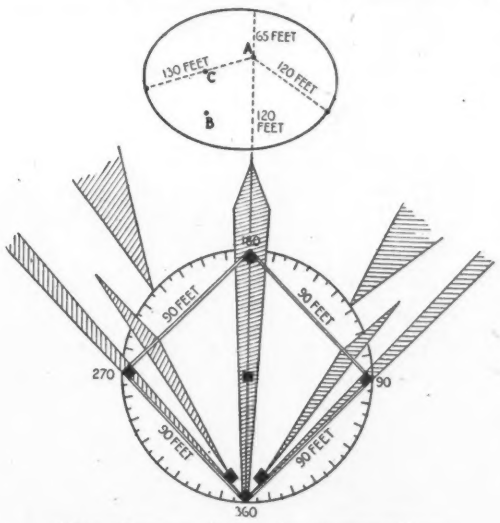
Mr. Frank B. Gilbreth, the motion-study expert, has thus found that a ball pitched by a "crack" man reaches the prodigious speed of $2\,^2/_5$ miles a minute. Traveling at the rate of $2\,^2/_5$ miles a minute, a ball would cover 210 feet in one second.

The high-speed motion-picture camera also recorded, in the particular case studied, that .99 seconds elapse from the time the pitcher starts to "wind" until the batter hits the ball. It requires .88 seconds for the ball to leave the pitcher's hand and be struck by the bat. One catcher recovered in .1317 seconds, and it took him only .796 seconds to throw the ball to second base.

Time Is the Big Factor

Having assimilated these facts, it will be interesting to solve a few baseball problems. It might be well to mention here that the system of mathematical reasoning followed out is accurate enough to be applied to the problems of any team, and managers should find it a great aid in planning new plays. The use of this system is scientific baseball to the *n*th degree. It will tell the possibility or impossibility of virtually any play where time is a consideration. Time is the biggest factor in baseball, and calculations along these lines are merely a matter of simple arithmetic and a good stop-watch. The Navy has recognized the value of time study; why not baseball managers? How long does it take a man to pick up a baseball and throw it? How long does it take a pitcher to turn and throw the ball to second base? Such facts must be made known before "scientific" baseball becomes a reality.

Assume that the center fieldman is at his usual position *A* in the center field. A swift drive off the end of the bat goes over the shortstop's head and lands at *B* within the center-field territory. The fieldman, using his judgment, figures that he can intercept the ball at point *C*, and runs to this position from *A*, where he was standing. The ball travels at an average speed of 120 miles an hour from the batter to point *C*, where it is picked up by the fieldman. The distance covered by the ball is just 240 feet—the time an infinitesimal fraction under 3 seconds. The fieldman requires 2¾ seconds to make up his mind and to get to the point where he can get the ball. By the time the fieldman gets ready to throw the ball to first base, the runner will be past this point and on his way to second base.



This diagram shows the "grooves" on a baseball diamond. The grooves are difficult to cover. When the bases are full, balls falling within them are almost sure to be safe hits

The question is: Did the runner hit a two-bagger? Mathematics will tell whether he did or not long before the physical action of the play could be carried out. The runner would be crossing first base just as the fieldman was winding up his arm to throw the ball to second base. The short distance of the fieldman from second base should enable him to throw the ball to this point at the rate of about 120 miles an hour. The distance to be covered is about 100 feet. At this rate of speed the ball will reach the second baseman's glove in a little more than half a second. The rest is apparent. It would take the runner more than three seconds to get to second base, and the ball would beat him to second base by about two seconds.

The Secret of Good Ball-Playing

Although the real science of baseball has never been gone into very deeply, the investigation that has been conducted reveals some very startling facts. Of course, if baseball-players were automatons, plays could be figured out with greater mathematical precision. With men, however, the human equation enters into the consideration. Each man on a team has a "psychological factor" that cannot be ignored. This psychological factor is really the "nervous reaction time," which is never the same in two men. Nervous reaction time is the time between thinking about an act and actually performing it. Every good ball-player must have a very short period of nervous reaction time or—well, he won't be good. Quick plays and "brain-work," as the fans call it, depend entirely upon this factor.

A player is at the bat. The pitcher winds up. There is an instant of suspense. *Whizz!*—the ball leaves the pitcher's hand. The batter draws back the bat. The ball approaches. He thinks it is a straight ball. He swings. At the instant before he swings he sees the ball "break" from its straight path. It is too late. His nervous

reaction took too long. Another man might have hit the ball.

Before really scientific baseball can be introduced it will be necessary to make a psychological record of each man on the team. Such a record, together with data made available through scientific time study, would reduce the playing of professional baseball to an accurate basis. The speed of runners, the speed of pitched and batted balls, are the most important factors.

More light on these factors is needed. It would promote baseball to a real science. This would by no means limit the human factor in the game. In fact, it would tend to attach more importance to the selection of men with keen, rapidly working minds. The real game of baseball today is merely a battle of time, although the fans in the grandstand do not fully realize this.

Making Baseball More Scientific

The skeptic will say, "Baseball is as scientific today as it ever will be." Here is a little problem for the skeptic: A certain play is described in the forerunning part of this article. It is shown how a man batting a ball to the center field would be able to make only one base. The ball was batted to a certain position in the right-hand part of the center field. What if it were batted to the left-hand part of the center field?

"It wouldn't make any difference," the skeptic says.

It would make a great difference, although this fact would not be known at the present time if some work had not been done on the time study of the game. It has been found that the fieldman can turn and cover more ground running in the right-hand direction than in the left-hand direction. The diagram will illustrate this. The fieldman is able to cover only 120 feet in the left-hand direction, while he can travel 130 feet in the right-hand direction in the same time. It has been found that a fieldman can run 120 feet forward in the same time that he would take to turn around and run 65 feet backward.

The game of baseball as it stands today awaits the touch of some great genius. Those who are familiar with the history of the game understand how it has progressed in the past twenty-five years. The end is by no means in sight. A lot has been said about the "scientific game," but it is not yet deserving of this flattery. Some day a scientist will step out on the ball diamond with a collection of accurate time-measuring instruments, and from that day on "the scientific game" will come into its own.

Few people interested in baseball really understand the mechanics of throwing the ball; yet this is one of the important scientific phases of the game. In this respect a ball obeys well defined physical laws.

Where the mathematics of the game runs into very small fractions. A thrown ball travels more than six times faster than the average man can run. A runner must have a good start or he will lose

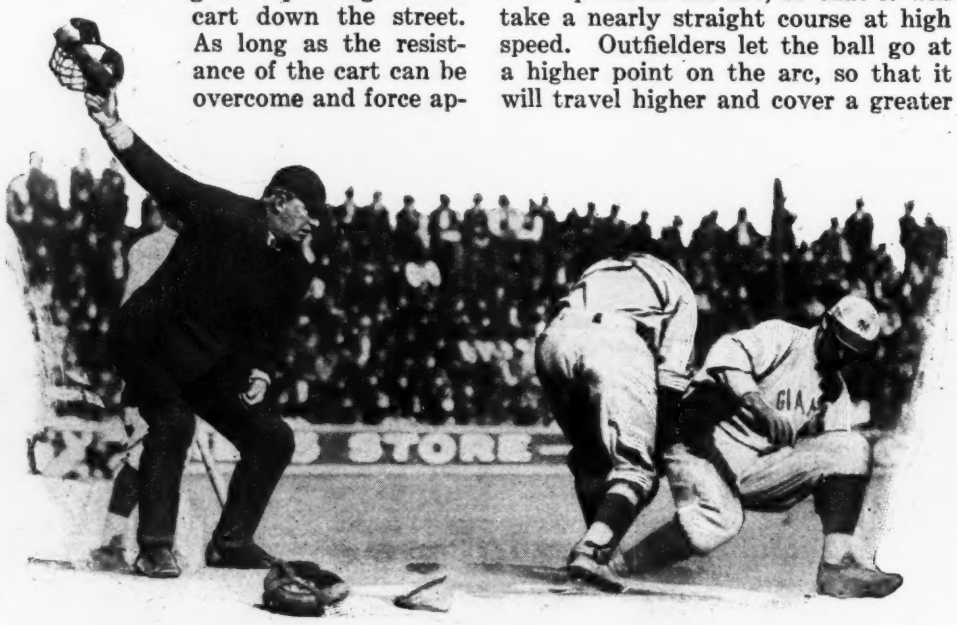
The time required for a ball to reach any point depends entirely upon two factors: initial speed and initial angle. The ball will not reach a speed any greater than the hand of the player reaches in its swing. This is analogous to pushing a small cart down the street. As long as the resistance of the cart can be overcome and force applied, the speed of the cart will increase. When the cart reaches a speed where it is traveling as fast as the pusher can run, no more force can be applied and the cart cannot be made to go faster. The same holds true of a ball leaving the hand: it cannot reach a speed any greater than the thrower's hand attains.

The Long Arm and the Fast Ball

Compare a ball-player's arm with the spoke of a wagon-wheel when considering the mechanics of ball-throwing. It is known that the outermost end of any spoke travels faster than the end near the hub, and that the longer the spoke is, the greater the difference in speed will be. The longer a ball-player's arm, the faster will he be able to throw a ball. The great speed of Walter Johnson's throwing has been attributed to the inordinate length of his arms.

Swift ball-throwing can be attained by constant exercise —by gradually making the hand travel faster. Short-armed players sometimes overcome their difficulty in learning to snap their wrist at the instant the ball leaves their hand. This imparts greater speed to the sphere.

Throwing the ball accurately depends upon the "initial angle." In throwing a ball, the hand moves in the arc of a circle, and when a ball leaves the hand it flies out along the tangent to the circle at the point where it left. The initial angle determines the trajectory of the ball. Infielders and pitchers always throw the ball at a low point in the arc, so that it will take a nearly straight course at high speed. Outfielders let the ball go at a higher point on the arc, so that it will travel higher and cover a greater



If the "ump" were a rapid calculating machine his decisions would be more accurate, but not necessarily more pleasing to the players

distance. The ball must leave the hand at the proper instant—just as the hand reaches the proper point in the arc it describes. Infielders pitch with a falling trajectory, and outfielders pitch with a rising trajectory for long throws.

The physical principles involved in pitching curved balls form one of the most absorbing phases of the scientific game. The secret of pitching curves lies in making the ball spin as it leaves the hand. This spinning causes the ball to behave in a certain way as it travels through the atmosphere. The spinning ball causes the air in proximity to it to be dragged into motion.

Curved Balls and Air

On one side of the ball the air will be spinning around in the direction that the ball is traveling. On the opposite side the air will be spinning in the reverse direction and a pressure will be created. On the side of the ball where the air is spinning in the direction that the ball is traveling in, a lowering of pressure is brought about. Thus a higher pressure is brought to bear on one side of the ball, which forces it out of the natural course it would take if it were not spinning.

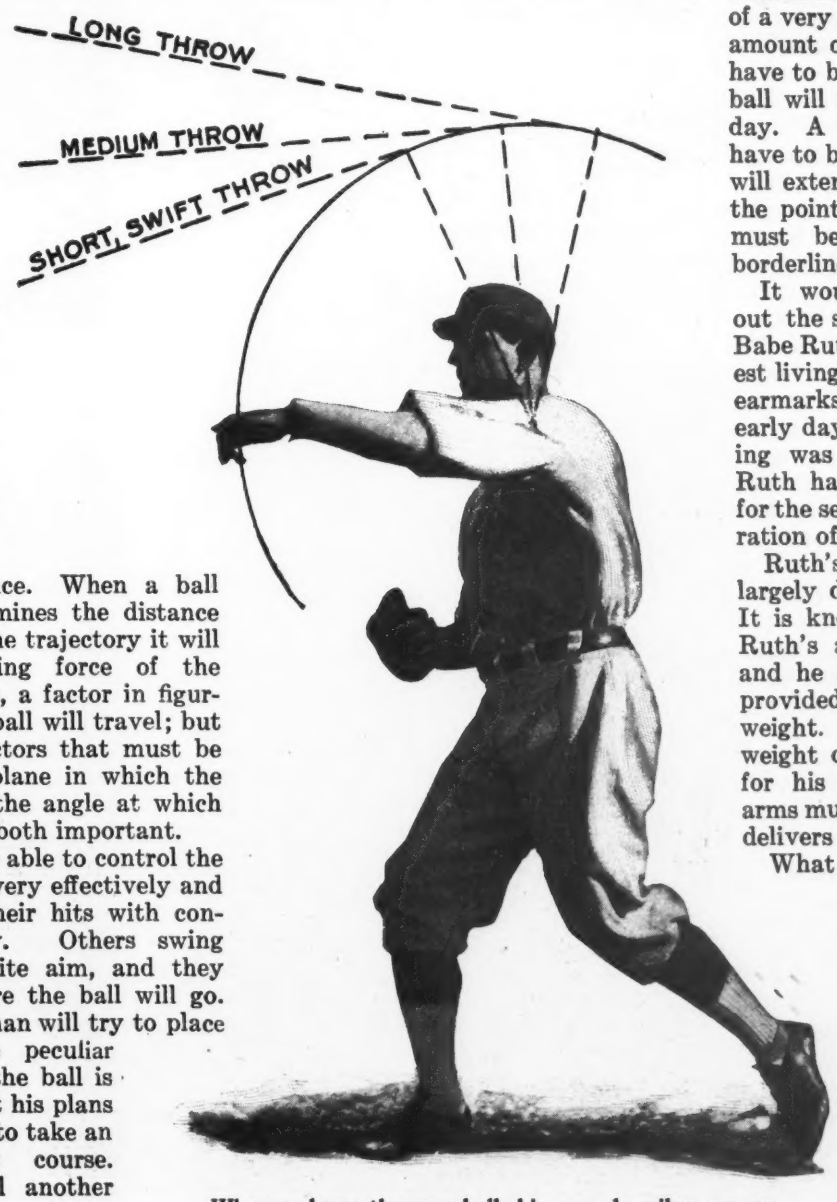
The science of the game does not end here. It can be applied to everything that happens. Take batting, for instance. When a ball is hit, what determines the distance it will travel and the trajectory it will make? The striking force of the player is, of course, a factor in figuring the distance a ball will travel; but there are other factors that must be considered. The plane in which the bat is swung and the angle at which it hits the ball are both important.

Some players are able to control the motion of the bat very effectively and thereby "place" their hits with considerable accuracy. Others swing without any definite aim, and they do not know where the ball will go. Oftentimes a batsman will try to place his hit, but the peculiar manner in which the ball is pitched may defeat his plans and cause the ball to take an entirely different course. Thus, this is still another factor that helps to determine the path a ball will take when it leaves the bat.

If the player wishes to hit a grounder, he must strike the ball at the correct angle. If he wishes to make a field hit, he must get the bat under the ball. Fast drives are made by striking the ball squarely in the center. A fast fly ball must always be struck in the exact center, but *at a different angle.*

Readers who have a general knowledge of mechanics may have trouble in understanding how two objects moving in opposite directions act when they strike each other. If two locomotives of the same weight and size, traveling at the same speed in opposite directions, were to collide, both their motions would be overcome. The same does not hold true in the case of a ball being struck with a bat. Many people believe that the striking force of the ball is subtracted from the striking force of the bat. This is not true. The striking force of the ball is *added* to the striking force of the bat.

If a ball is thrown against a stone wall it will rebound. The faster it is thrown the greater the rebound will be. The faster a ball is pitched the greater the distance it will go if it is struck properly. If balls were pitched slowly, home runs would be impossible and Babe Ruth would just be an ordinary player.



When a player throws a ball, his arm describes an arc. The ball leaves at a certain tangent to the arc described by the player's arm. Short-armed players usually "snap" their wrists to impart greater speed to the ball

What the Striking Force Depends On

The striking force of a batsman depends upon several things: the speed at which he causes the bat to move, and his muscular force, aided by the weight of the upper portion of his body. The weight of the bat must also be considered. The heavier the bat is, the greater its striking force will be when moved at a certain speed. The length of the arms also figures. A man with long arms has just that much more leverage. This does not mean that all players with long arms are good batters. The human factor may or may not be favorable to good batting.

So runs the science of baseball. This article only scratches the surface of a very interesting subject. A great amount of serious research work will have to be done before scientific baseball will mean more than it does today. A vast amount of figures will have to be compiled, and these figures will extend the science of baseball to the point where the human equation must be considered. Beyond this borderline it cannot go.

It would be interesting to figure out the striking force of a man like Babe Ruth, who is probably the greatest living batsman. He bears all the earmarks of the old "sluggers" in the early days of the game, before pitching was understood as it is today. Ruth has made eighteen home runs for the season up to the time of preparation of this article.

Ruth's tremendous striking force is largely due to the weight of his bat. It is known as the "big black bat." Ruth's arms are of ordinary length and he is more or less helpless when provided with a "stick" of average weight. It is probably the extra weight of the bat that compensates for his arms. The muscles in his arms must also be well developed as he delivers a terrific impulse to the ball.

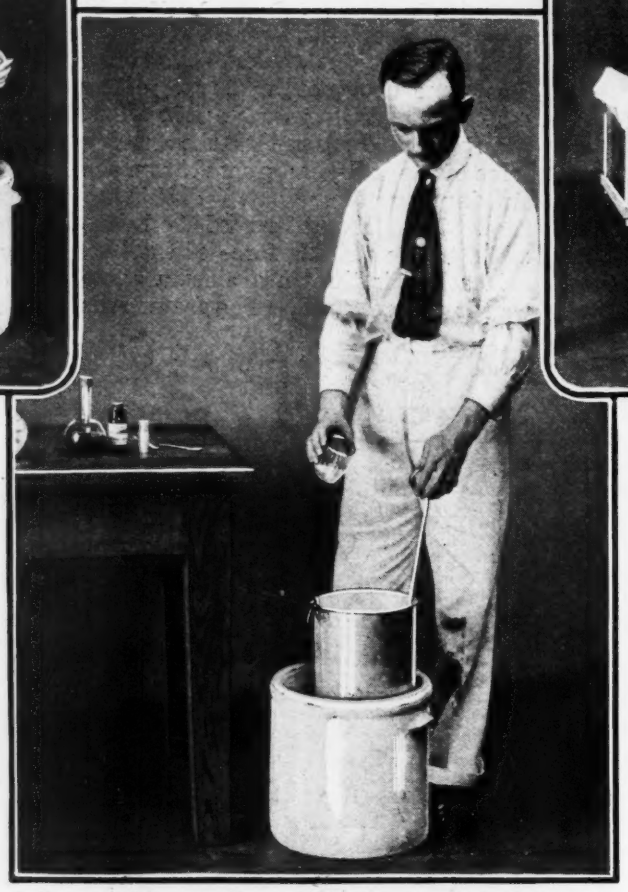
What this impulse is in pounds and ounces above the average player no one knows because up to the present no one has analyzed the motion of exceptional players.

The above analysis, which attempts to account for Babe Ruth's extraordinary skill as a batsman, may or may not be correct. Probably a thorough scientific study of his batting would reveal other facts that would account for his heavy hitting.

Make Your Own Cottage-Cheese

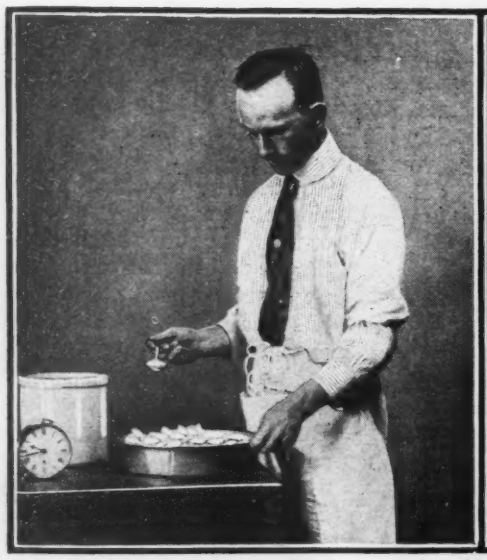
One way to keep down the H. C. of L. Sweet skim-milk, formerly fed to pigs, is turned to cheese in ninety minutes

The skim-milk that remains when all the cream is taken from fresh milk has been considered by farmers unfit for human use. But now it is made into cottage cheese by this new process. First it is given a hot-water bath at a constant temperature of seventy-five degrees Fahrenheit. To it a pint of clean sour milk is added and the two are well mixed together

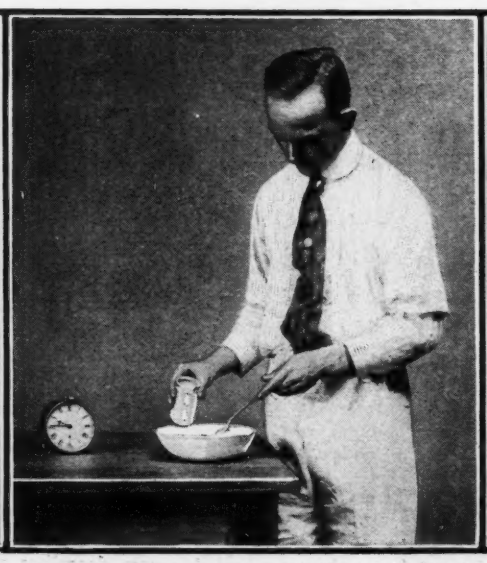


A "coagulating agent"—possibly rennet, obtained from the stomach of a calf—is dissolved in water and added to the now sweet and sour milk. This "agent" eliminates the usual boiling

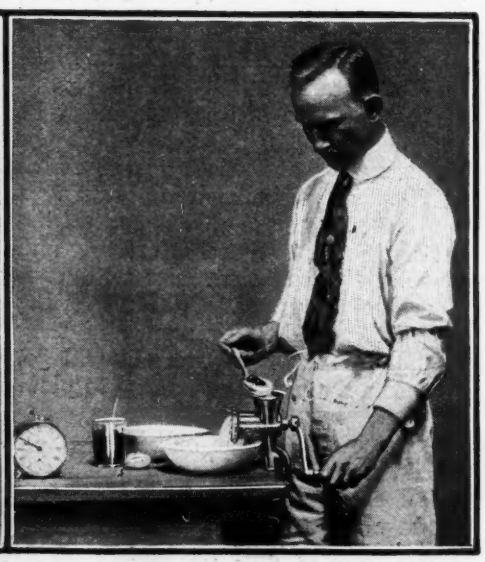
The can is covered while coagulation takes place. When the milk has reached the proper thickness, it is poured into a straining-cloth, and the curds and whey are thus separated. If the whey doesn't drain rapidly it is sometimes squeezed out by applied pressure. Usually the cloth is gathered up to form a bag, and a weight is placed on it for a few minutes



When the very last drop of whey has been squeezed out of the clean white curd, salt is added to supply it with sufficient character



If a half pint of cream is added to the salted curd it will make it much richer, smoother, and almost like the dairy's triple-X cream

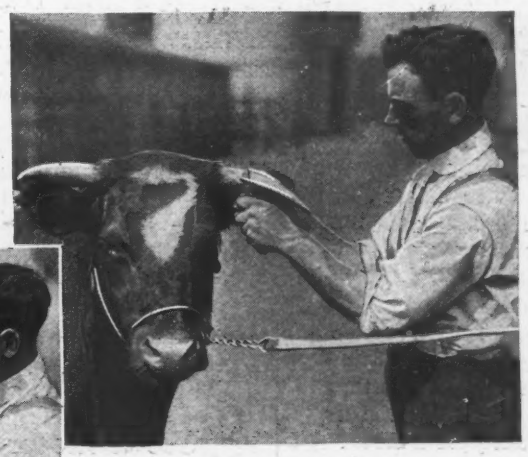


Pimento and onion are now added. Then the cheese is run through a meat-chopper to assure thorough mixing, and it is ready to serve

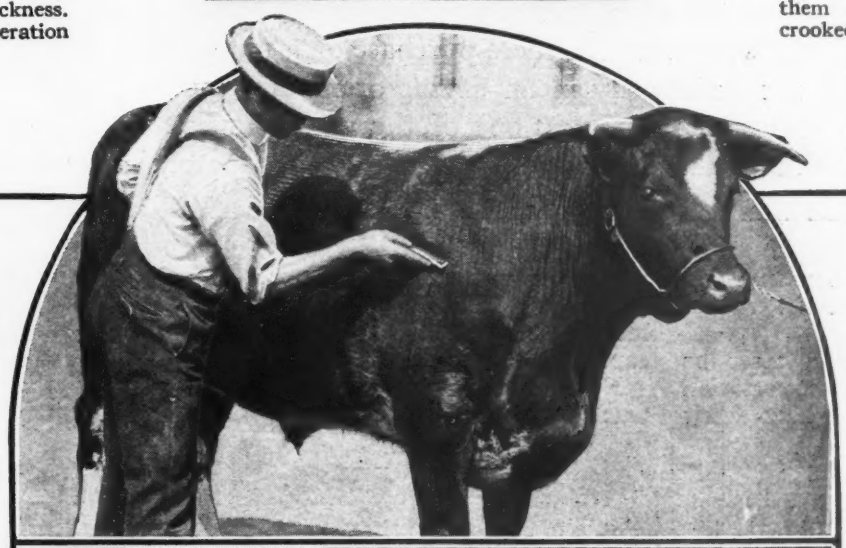
Barbering a Shorthorn for the Beauty Show

One of the most important details in a shorthorn steer's toilet is the beautifying of the horns. They must be filed till they are smooth. There are rules about horns: they must grow in the proper direction and be of exactly the right thickness. The color also is a consideration

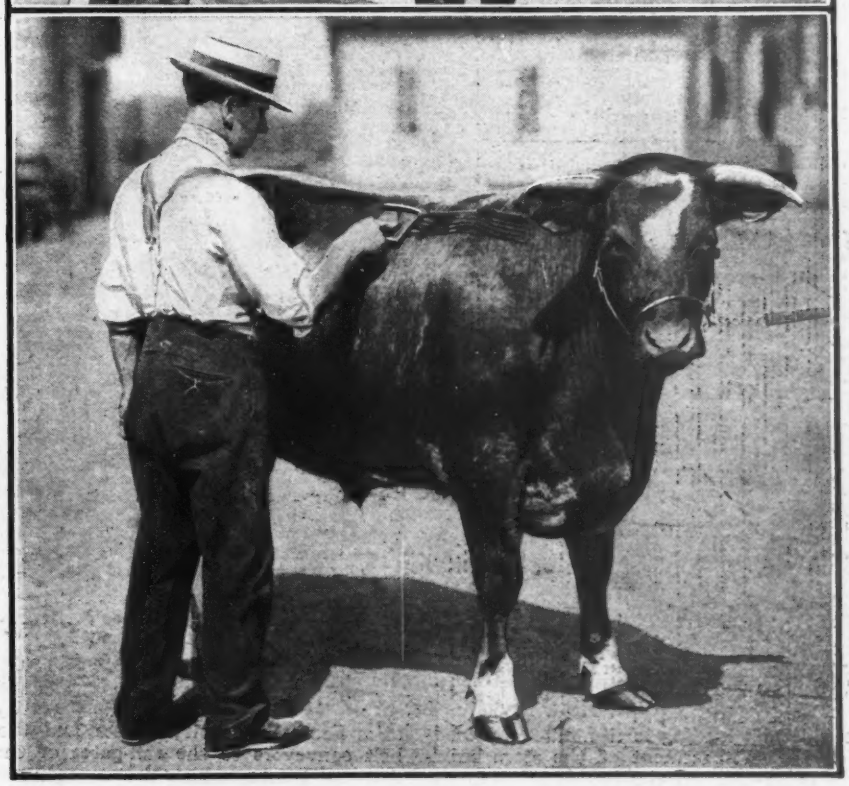
Now for the fina. polishing. It is done with an emery cloth. Great care is taken not to disturb the cowlick, which has been plastered in place



Manicuring horns is a slow, tedious job. First they are shaved until they assume a graceful shape. Fortunately, this is not a painful process. While the horns are growing the animal's owner watches them carefully. If they are crooked, he ties weights to them



This brave beauty shown on the right scarcely moved while his hair was drying, lest he disturb it, as if he knew perfectly that he was getting ready for the event of his life. When the hair was thoroughly dry the hairdresser marcelled it; then he fluffed it up with a comb. When he had finished, the animal had all the outward appearances of a prize-winner



But, before all the beautifying processes we have described above, Bossy must be soaked, soaped, and scrubbed. This picture shows him fresh from his bath and still wet. His hairdresser is marking his coat off in long parallel furrows with a currycomb. Don't you think he has the air of a dressed-up boy—feeling foolish, but nevertheless proud?

Saving Time in Loading Motor-Trucks

How the old method of sidewalk loading has been eliminated in modern department-store construction

By Joseph Brinker

"KEEP the truck moving." That motto ought to be posted in the shipping-room of every company that uses fleets of motor-trucks.

Horses and motors differ fundamentally in this: Continuity of operation reduces the efficiency of a living muscle but increases that of an engine. If a horse is to make money, he must rest frequently; if a motor-truck is to make money, it must move constantly.

The *Great Eastern*, the most daring experiment in shipbuilding made in the nineteenth century, was a failure. Why? She could not be loaded and unloaded quickly enough. There were nc adequate means for speedily collecting freight in those days. Thousands and thousands of dollars a week were lost by holding her in port.

A fleet of motor-trucks must be operated on railway transportation principles. They must have their specially built and equipped terminals —their loading and unloading stations. Conveyors, chutes, sorting-bins, every conceivable device that will cut down hours to minutes and minutes to seconds in loading and unloading a truck, must be installed. The motor-truck is the most economical highway vehicle in the world if it is worked to capacity.

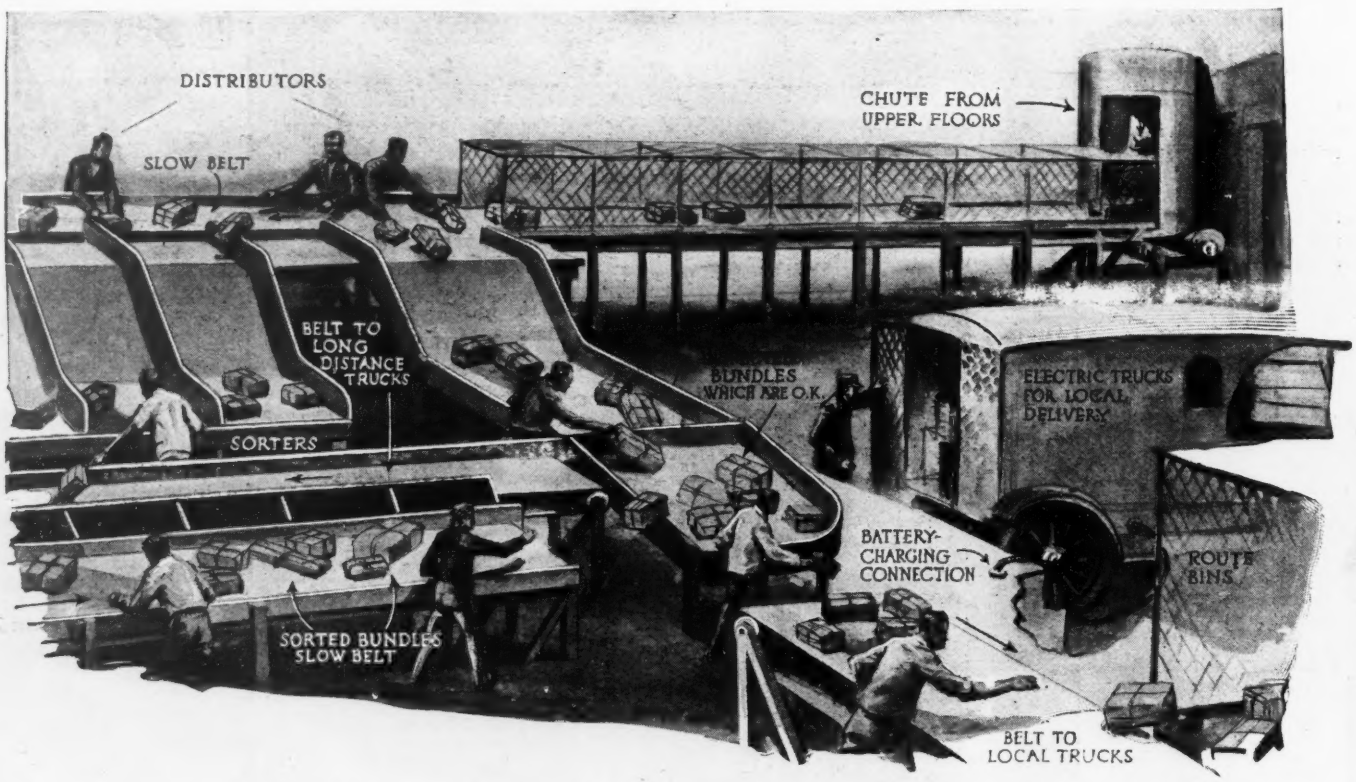
No better proof of the motor-truck's adaptability, no more striking example of the correct application of the "Keep the truck moving" principle, can be found than those practices which have been adopted for package delivery by wel! known department-stores in many large cities, some of which are described here.

Slow loading even of horse-wagons is wasteful. In the old days it was condoned because the cost of horse operation was small and delays gave the horses a rest. But if it should take the same length of time to load a motor-truck as a horse-wagon, the cost of the idle time of the truck would be double or three times that of the horse vehicle. When a company has a fleet of ten or twenty trucks — and some concerns have as many as one hundred—the cost of the idle truck time becomes so great that many firms have been forced to take cognizance of it and reduce the loading time. In package-delivery work, this has

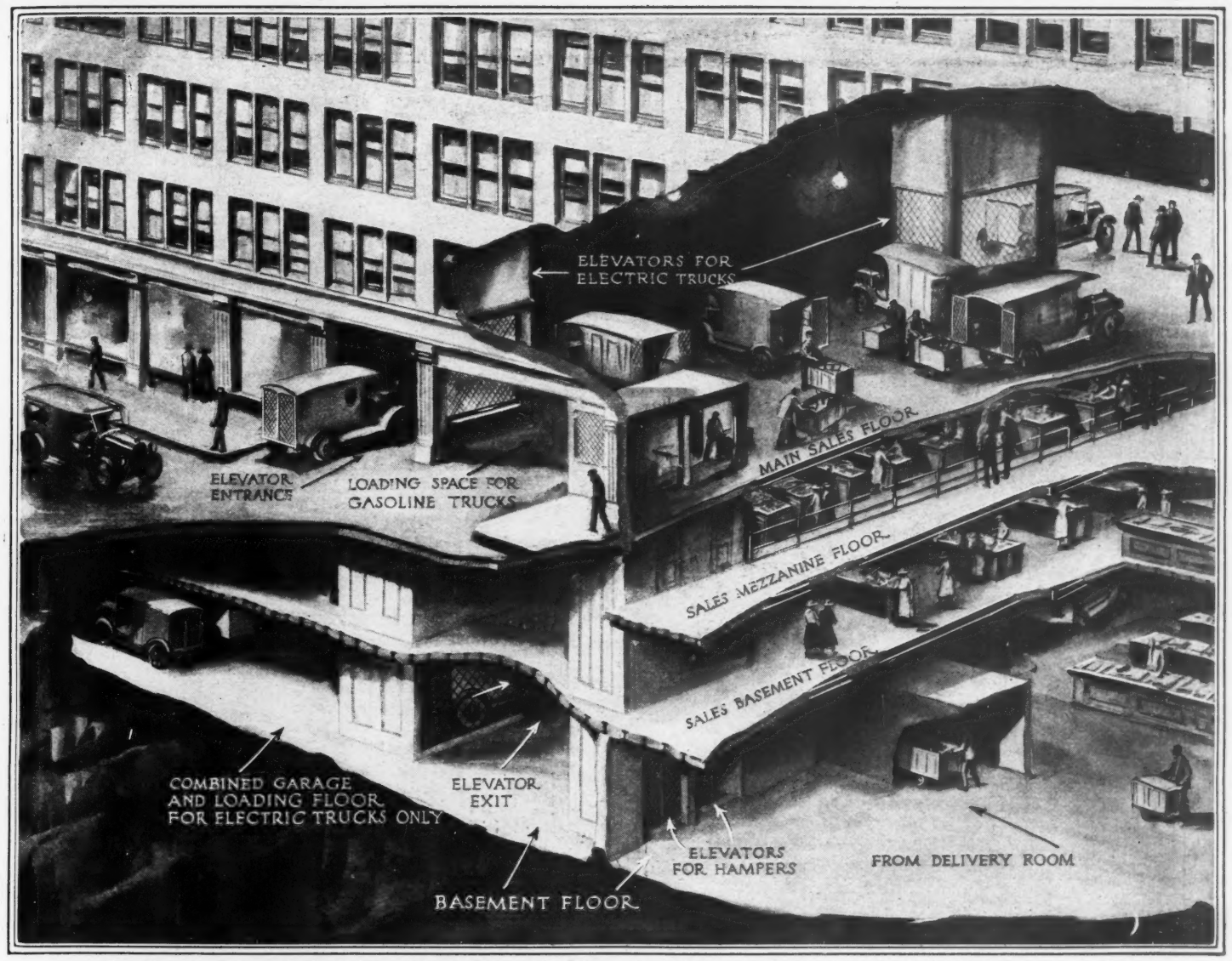
How Motor-Trucks Save Money

Use a motor-truck as if it were a transportation system. Operate it as if it were a railway. It will save money for you, and make money, too, because of its great serviceability.

In this article, the third of the Popular Science Monthly series on the business uses of the motor-truck, we show that the mere purchase of a motor-truck does not necessarily mean saving or making money. You must get the most out of the motor-truck, and to do that you must have a properly equipped motor terminal.



In this instance, sidewalk loading is eliminated by loading the trucks in the sub-basement of the store building, the packages being sent to the basement from the sales floors by gravity chutes and then distributed by belt conveyors to the tail-gates of the waiting electric delivery trucks, which are charged while being loaded



Another store has eliminated costly and slow sidewalk loading by taking the trucks entirely inside of the building. On the street level there is an alleyway leading through the store from one street to the next. The gasoline-trucks are loaded in the alleyway, the packages being brought up in hampers from the delivery department in the lowest basement floor by two small elevators. The electric trucks, used because they give off no poisonous exhaust gases, are loaded in a combination loading-bay and garage three floors below or on the same level as the delivery room

been done principally by the elimination of sidewalk loading. Two of the methods used in one large city are shown in these pages.

Analyzing Loading Systems

A loading platform is like a city street: if it becomes congested, a factory's entire internal system of transportation is clogged. Pushing boxes across sidewalks is time-wasting and therefore money-wasting. In sidewalk loading the truck-driver must travel back and forth between the curb and the store with small portions of his load. To route his load or place the packages in the body so that they may be picked out in the order in which they are to be delivered, requires that all the packages first be laid down on the sidewalk for sorting. Think of the confusion this entails and the time it takes when the store happens to be located on a busy street. Then again, think what happens when the goods must be loaded in bad weather. Some of the goods are damaged, even when tarpaulins are used temporarily during the loading operation.

By eliminating sidewalk loading, one large Chicago department-store saved five thousand dollars a year in canvas covers and fifteen thousand dollars in motor-truck time. Such economies are of the utmost concern to purchasers of goods. The cost of retail delivery is included in the selling price of goods. Therefore, if the cost of delivery is increased by slow sidewalk loading, the price of the goods must be increased. The charge is passed along to the final consumer, and you and I, who may never own a truck, pay the bill.

In some few instances, sidewalk loading has been eliminated by taking the entire delivery room, with its route-bins, conveyors, and the like, out of the main store, and placing it in a separate building in a neighborhood where rents are cheap. The delivery room in this case may be combined with the garage or warehouse. It is then necessary for delivery trucks to visit the main store, everything being loaded at the separate station.

While this plan gives an increased amount of sales space in the store, it necessitates the introduction of larger, vanlike trucks to haul the packages from the store to the delivery station. In large cities where rents in the business district are continually mounting, and where the stores have large fleets of motor vehicles, this plan may ultimately become general.

Another plan is to design the ground and basement floors of the main store building so that the trucks themselves may be brought inside for loading, even though the garage be some distance away. Elevators are sometimes employed to get the trucks into and out of the basement; while in other cases ramps are used.

Ramps Built for Loading

Where ramps are used they form a part of the building's original design, the delivery problem being considered before the building is constructed in-

stead of afterward, as is most generally the case. In each instance, however, the electric trucks used are garaged at night in the same space as that used for loading in the daytime. This means a considerable saving in itself.

In both cases it will be noticed that the lines of incoming and outgoing trucks are segregated to eliminate congestion delays.

The principles which have been adopted by department-stores are so clearly set forth in the accompanying illustrations, that it is unnecessary to burden the reader with extended explanations here. In all cases the principle is the same—the loads or packages pass in an endless stream to and from the truck.

One large grocery firm drops packages in a few seconds through six floors down a spiral chute. Elevators would take ten or fifteen minutes to do the same work. A Pittsburgh department-store has installed two escalators; one lifts packages constantly upward from the sub-basement to the loading-bay, and the other carries back empty boxes and hampers.

It once took one and a quarter hours to load a vehicle owned by a large department-store in Providence,

A New York Store's

Here sidewalk loading is eliminated by placing the entire delivery room on a concrete island platform in the sub-basement. Trucks reach the loading platform by ramps from the street. Incoming trucks use one ramp, and outgoing trucks use another, to avoid delays.

The electric trucks are run up to the platform, where the batteries of the vehicles may be charged or given a boosting current while the loading is being done. At night the electrics are garaged in place at the loading platform. The packages reach the delivery room from the floors of the store above by a gravity spiral chute, and are mechanically moved in front of the route-bins on a belt conveyor

System of Loading

Above may be seen the two belt conveyors, separated by aisles in which sorters stand, picking out the packages as they pass and throwing them into sorting-bins, one for each driver's route-bin or cage. Sheet-writers then record the packages on sheets, one for each route, and throw the packages into the drivers' bins, from which they are later loaded directly into the waiting motor-trucks. The sheets with the packages listed on them tell the driver how many packages he has to deliver and where.

All the package handling and loading is thus done indoors where work is not slowed up by the weather, and where damage to packages is reduced to a negligible quantity

Rhode Island, on the old sidewalk principle; now it takes a few minutes, because the shipping-room has been rearranged.

The installation of a certain roller gravity conveyor by a large soap-maker made it possible to load a waiting motor-truck in ten minutes instead of twenty-five; the loaders do not have to lift the box, but simply to guide it as it comes down the conveyor.

Time lost in stopping, in loading and unloading, in needless waiting for a chance to run into a delivery-bay, is money lost. If the units of a whole fleet of motor-trucks are delayed, the aggregate time lost may amount to weeks in the course of a year, and the money lost to thousands of dollars.

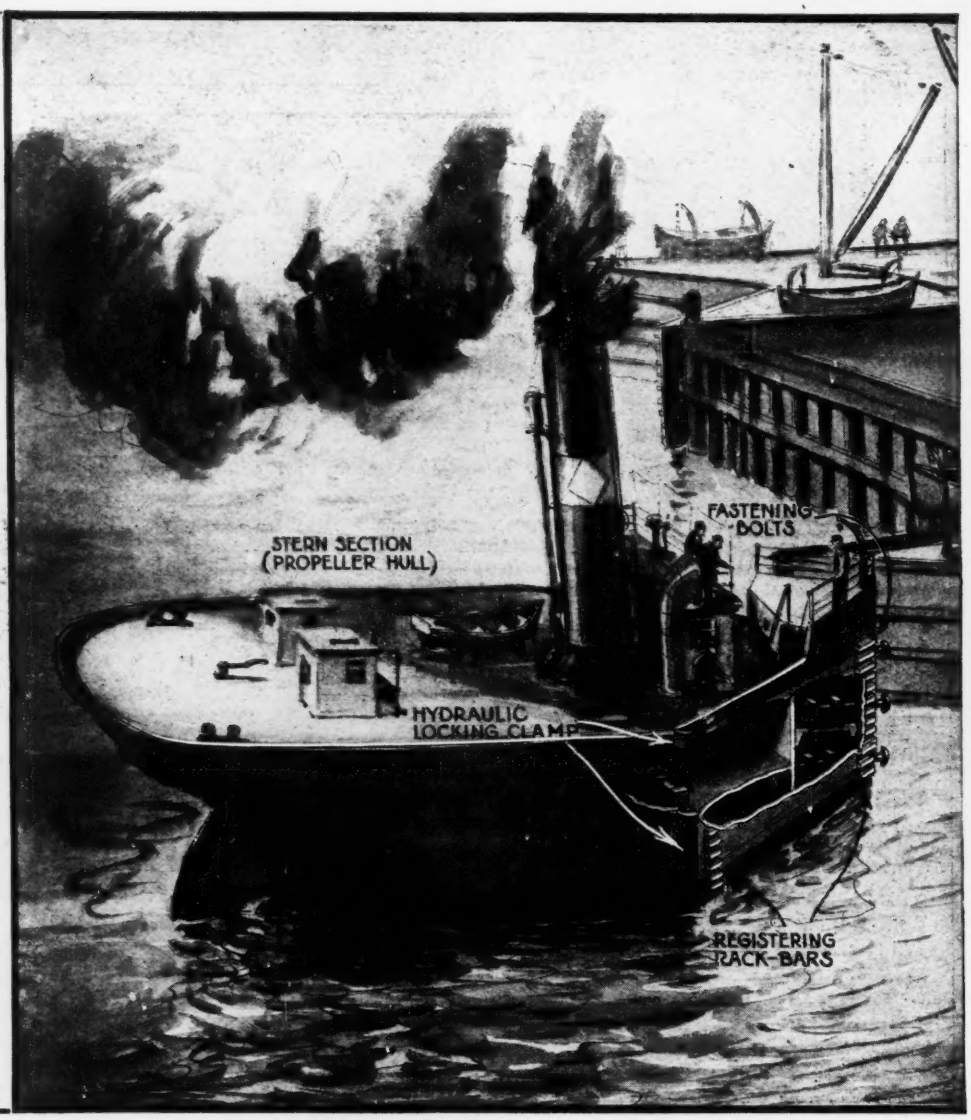
One of the first lessons that the motor-truck buyer must learn is that of providing adequate shipping-room facilities. Never must he forget that horse-wagon methods are not applicable to machine-propelled vehicles. Let him study the railway terminal—the better sort of railway terminal—and let him apply the lessons that he there learns to his own business, even to the extent of having time-tables for every route followed by his motor-trucks.

One Set of Engines for a Dozen Hulls

IT costs from $500 to $3000 a day to keep a steamship idle at its dock. The amount of loss depends on the size and on other characteristics of the ship. Most of this loss could be avoided if it were possible to use the ship while it is loading or unloading.

An English engineer, Snell, sought to solve the problem by placing the power plant in a separate compartment which could be attached, whenever needed, to the hull of any cargo ship adapted for that purpose. The principal disadvantage of Snell's plan was that the transfer of the power plant from one hull to another required the use of a dock and special hoisting machinery.

M. Constan, formerly director of the School of Hydrography at Saint-Brieuc, has found a similar but apparently more practical solution of the same problem. The power plant is carried in a separate hull, independent and self-supporting. The bow forms an angle of seventy degrees and fits accurately into corresponding recesses in the hulls of two, three, or more freight-carrying vessels, any one of which may in turn be connected with the power-supplying hull.

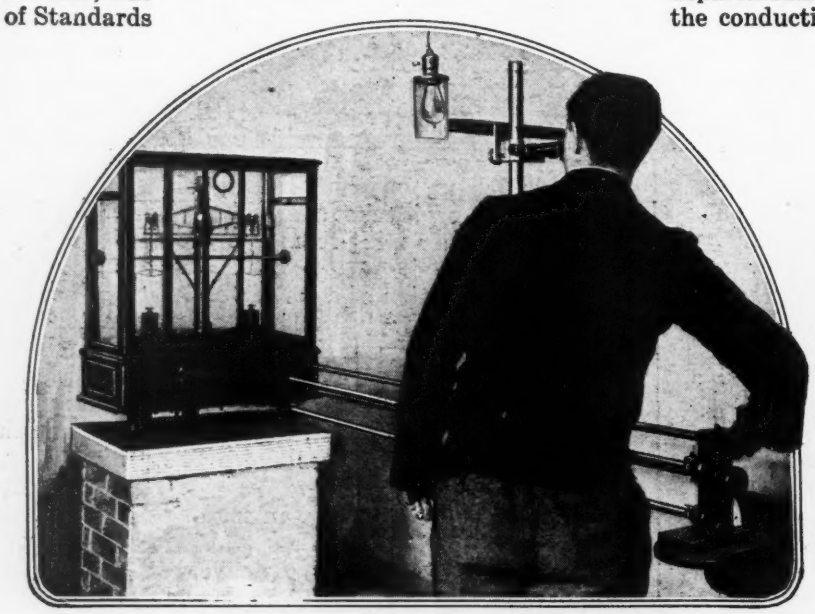


The two hulls, one carrying the power plant, the other the cargo and an extra supply

With This Apparatus You Can Weigh Your Signature

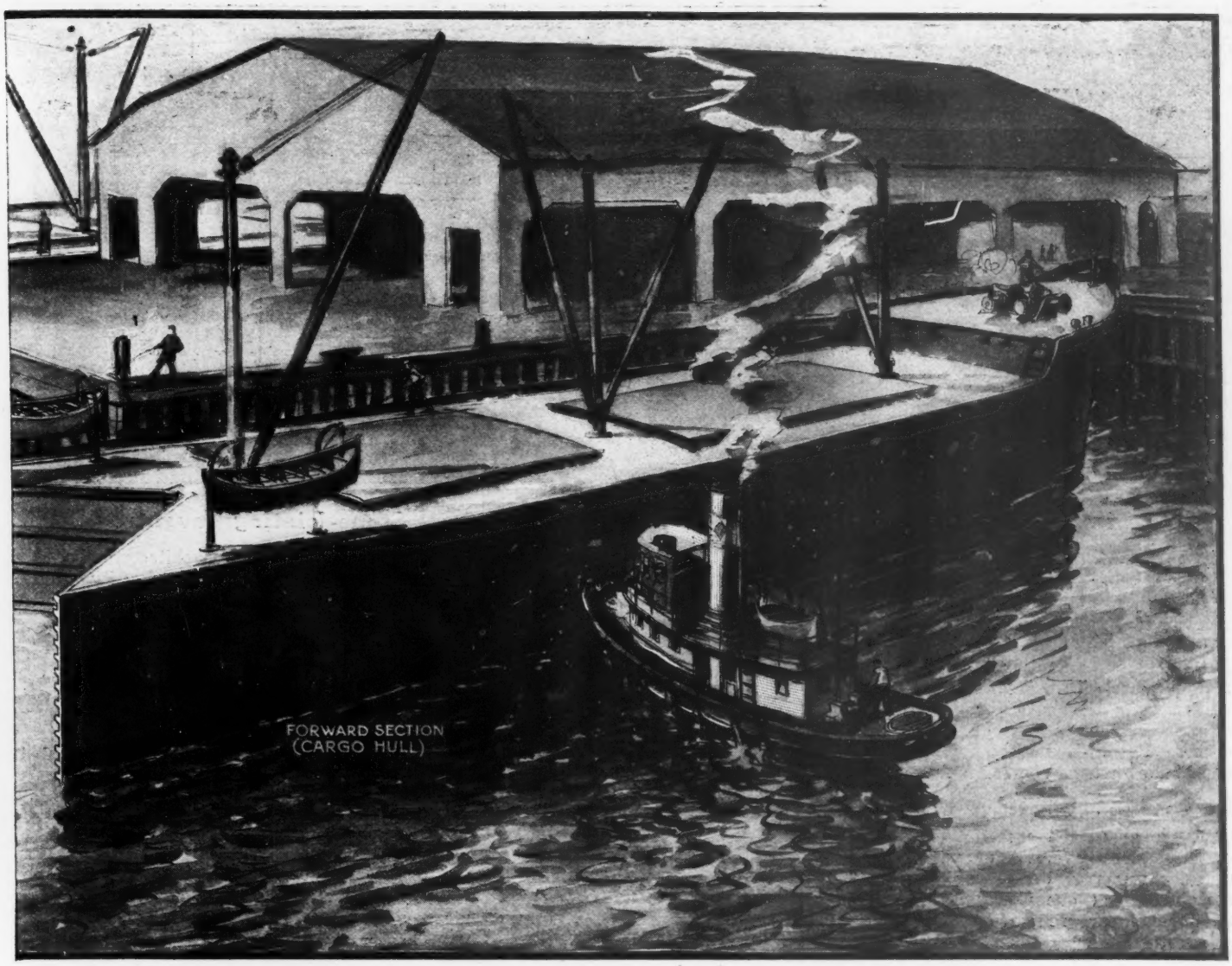
FIGURATIVELY speaking, Congress may know the weight of President Wilson's signature when he passes or vetoes a legislative bill, but the United States Bureau of Standards is the one government department that can literally determine the weight of the President's signature—only one three-hundred-thousandth of an ounce. The precision testing balance used is the smallest in existence. It can weigh an eyelash, the ink in a signature, or even a dust particle. It is graduated to read to one-millionth part of a grain.

The photograph shows an operator conducting tests from a distance, the device being so sensitive that the heat from the observer's body would spoil the weighing. How can business men, manufacturers, municipalities, and states avail themselves of the practical uses of these finely gaged balances?



This scale is so finely adjusted that it will weigh an eyelash, or a signature by the ink's weight

Cooperation in establishing state departments of weights and measures, the conducting of field investigations, and the passing upon various types of weighing and measuring devices to ascertain their fitness for commercial use—these are among the practical efforts of the Bureau of Standards. The identical balance that reveals the weight of the President's signature may be an agency in uncovering fraudulent weighing apparatus—ultimately signifying that the housewife will have to pay less for her household necessities if she gets full weight for every dollar expended.



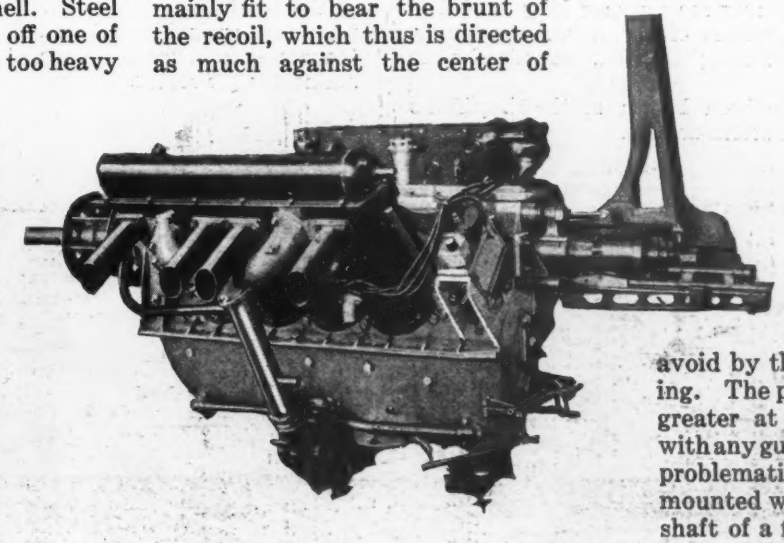
of fuel for the engine, are ready to be joined to form a single vessel. Connecting or disconnecting takes but a few minutes

Using the Engine Crankshaft of an Airplane as a Gun

IN a recent aircraft exposition was shown an airplane "cannon" which is mounted in the hollow shaft of the engine. It fires a shot of one pound weight. There is no armor that any aircraft could carry which could resist the force of such a shell. Steel plates thick enough to turn off one of the deadly missiles would be too heavy for the frail ships of the air.

Mechanical difficulties have been skilfully met. In firing from the center of the engine itself, shells had to be kept out of the space swept by the propeller blades. The usual way of solving this problem was to use a synchronizing mechanism so arranged that shots of the gun would fire at the right moment to avoid striking the propeller. The use of such large shells made it unsafe to trust this device, for the revolutions might not always synchronize properly. The heavier recoil had also to be properly controlled.

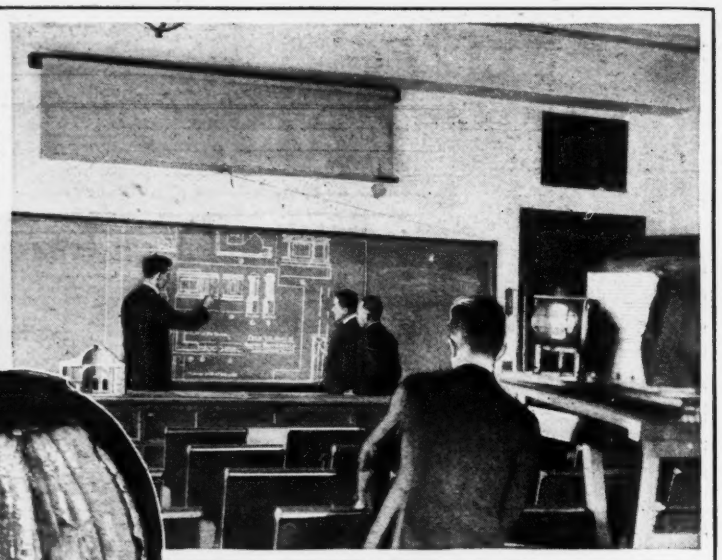
The solution was found in placing the barrel of the gun inside the hollow shaft of the motor. This high-powered engine, the most massive part of the "chasing plane's" structure, is mainly fit to bear the brunt of the recoil, which thus is directed as much against the center of gravity as the propeller thrust itself



Airplane engine equipped with a "cannon" capable of firing a one-pound shot through the propeller-shaft

The heavier armament would, undoubtedly, increase the efficacy of a highly mobile "chasing plane," but only under favorable conditions. The rigidity of the mounting of the gun is a decided disadvantage at long range. The pilot cannot aim the gun—he must aim his airplane.

It is clear that only clever maneuvering will enable him to bring the enemy's plane in the line of his fire. His only alternative would be to wait until the enemy crossed his line of fire. This the hostile flyer would try to avoid by the most skilful maneuvering. The probability of a hit is much greater at short than at long range with any gun, but it becomes extremely problematical if the gun is rigidly mounted within the hollow propeller-shaft of a fighting plane persuing an enemy employing every trick and maneuver for avoiding the line of fire



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Men with Yokes of Crime

JAPAN and China are great countries for making the punishment fit the crime. In fact, they are keen on punishment in general.

In China it is still the custom for criminals to stand in the public market place with a great wooden block around their necks on which is written the history of their crimes. Passers-by may stop, read, and make whatever comments they wish.

From the number of police necessary to guard the six criminals in the picture above, it would seem that they were truly desperate characters, and yet one would think their neckwear rendered them helpless.

Stone-jointing Taught by Lantern

AT the School of Architecture, Columbia University, New York City, there is an entirely new method of teaching stereotomy, also known as architectural stone-jointing.

A drawing is made of a typical joint and then a slide is made from the drawing. This is projected on the blackboard at the front of the classroom, as shown above. The instructor and pupils fill in the various sections with chalk, just as if the drawing were actually made on the blackboard. When the lesson is over the slide is removed for future reference and the chalk fillings are rubbed off the blackboard. This method obviated the necessity of drawing a new plan for each class. The same one, in slide form, can be used over and over again.

Umbrellas for Swiss Sharpshooters

IN Switzerland, when the soldiers practise target shooting, they make use of umbrellas to protect their eyes from the sun. Artists, the world over, use umbrellas for the same protection.

In hot countries the umbrella is an important part of the day's equipment. In the jungle one may see a savage king carried on state occasions upon the shoulders of his naked attendants, holding aloft a ragged, rib-protruding umbrella, the relic of some missionary.

And an umbrella has also been known as the shoplifter's friend; a handy receptacle for stolen articles.

A Four-in-One Banana

HAVE you ever peeled a fat banana and found four complete bananas within? Such a quadruplet is shown herewith. Each banana, naturally, is small, but is completely developed. Just why freaks of nature like this turn up every so often, no one really knows.

Next time you see a very fat banana, investigate it.

To find two nuts where only one should grow is a common experience, and one that causes no surprise; but this banana is a unique case.

A Railroad Run by One Man

SOME men cannot resist the desire to run a train. W. Cecil Gage, a broker, took up railroading as a hobby, and built a complete system, from tracks to rolling stock, himself.

From second-hand lumber and old wheels he constructed the remarkable little train seen in the illustration below. It is by no means a mere toy. The track runs around his estate, making connections with the barn, the wood-house, the ice-house, etc., so that a flourishing freight business is the result.

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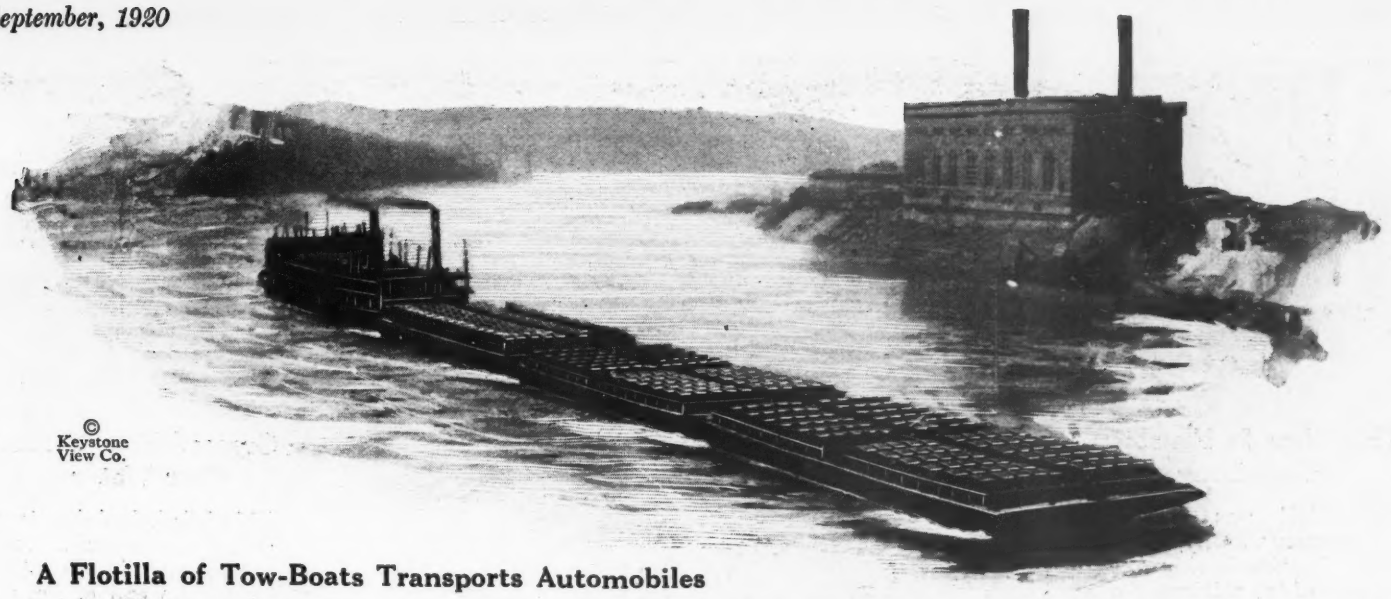


A Flotilla of Tow-Boats Transports Automobiles

MANY thousands of automobiles are sent from the factories to purchasers under their own power. But machines consigned to down-river points from the Michigan manufacturers to St. Louis, Memphis, and localities farther south, are conveniently transported by boat. No single steamboat is large enough to hold the numbers of automobiles thus to be delivered, so a flotilla of tow-boats has been used.

The flivvers and the larger cars are compactly crowded on the flat tow-boats, and these are grouped together or strung out in "tows" which are pulled by a side-wheeler of the ordinary river-type craft. Arriving at the point of distribution, the machines are unloaded and are started down the roads to points to which they are consigned.

Although there has been a shortage of chauffeurs to run the cars to their new owners, there has been no difficulty in obtaining young men of experience who are anxious to have the opportunity of making the trip. The method of delivering automobiles in this manner is economical, and it also helps relieve the congestion of freight traffic on the railroads.

High Cost of Wives in Africa

THE high cost of wives has hit darkest Africa. This is due to increasing values since the war. Before that a dusky maiden could be purchased for four cows or four spear-heads. But recently natives are complaining that the prices have been doubled.

The chief of the Masai tribe in British East Africa possesses two wives well supplied with metallic ornaments, and of great value.

Swimming Made Easy

THE new inflatable linen jacket which one puts on under his bathing-suit makes swimming or floating an easy and safe accomplishment for every one. The round inset in the picture above demonstrates the fine fit of the jacket and the simple method by which it is inflated. Wearing this jacket concealed under a bathing-suit, a mere amateur at swimming can swagger around with the best of 'em.

It is interesting to consider how the average man approaches the stage of being a "floating" rather than a sinking body. A piece of metal will sink if it is thrown into the water. If the human figure, a living, breathing body, is thrown into the water, a very little effort and skill will enable it to keep afloat for surprisingly long intervals.

A Bath for the Golf-Ball

RAY A. Minkler, of Carthage, Missouri, has patented a washer for golf-balls.

Brushes are arranged inside a container, with the cleaning fluid in the bottom. The handle holding the ball is plunged into the cleaner, up and down, until the friction of the brushes has restored the ball's original freshness. The friction of brush against ball turns the ball so that its every face receives a good scrubbing.

This Shoe Is Fourteen Feet Long

"THERE was an old woman who lived in a shoe—" Considering the number of her children, the shoe must have been the mate to the one shown above.

This great big shoe is seven and one half feet high and more than fourteen feet long. It weighs five hundred pounds. It is made of steel.

On the tip of the shoe you will notice a small black spot; it is a life sized shoe from which the large one was copied.

The two pygmy men standing by give you an idea of the steel shoe's immense size.

He Builds His Tower as He Climbs

PERHAPS you have seen Oriental acrobats on the stage thrilling their audiences with breath-taking stunts. But that's not surprising when we consider the fact that those same acrobats amused themselves at home when young by climbing flimsy towers like the one shown below.

This tower on the sand is made of wooden horses laid lengthwise and crosswise, the acrobat building as he climbs. A good stiff breeze would blow the whole tower over.

Army Boots to Be Made Over for Civilians

MILLIONS of hobnailed boots lost their jobs when peace was declared. The German ones, however, are being made over for civilian use. Above you will see a huge stack of them which were collected chiefly from the battle-fields. The nails will be extracted, and the leather will then be made over into peacetime shoes.

There is a great scarcity of practically everything in Germany to-day. Housing accommodations are insufficient; there's not enough food in the country to provide every one with three square meals a day, and many people are going barefoot.

What the coming winter will mean to all the countries of Europe is not pleasant to think of.

A Greased-Pole Contest Over Water

IN a Mississippi river town the boys evolved a brand-new "greased" contest that created no end of fun for spectators as well as for the boys themselves.

An old telephone-pole was anchored on shore, so that it extended over the river a few feet above the surface. The pole was greased, soft soap being used. The Stars and Stripes was fastened at the outer end of the pole.

A prize was offered to the boy who successfully walked the pole and returned to shore with the flag.

Of course one of the boys finally captured the flag.

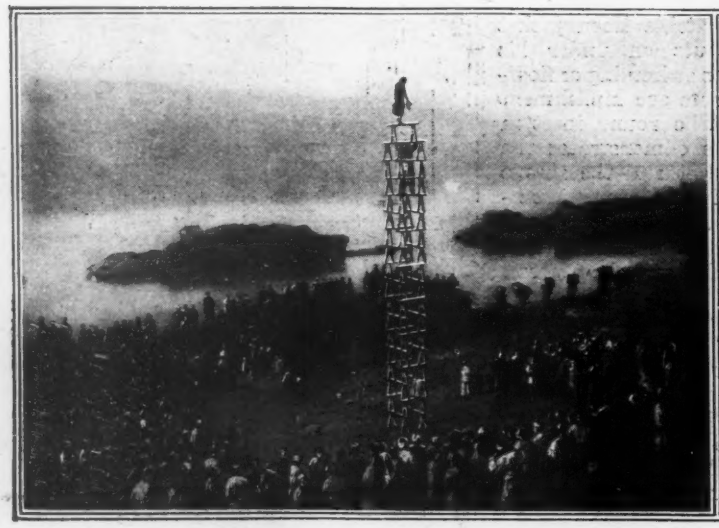
How the Chinese Dry Their Spaghetti

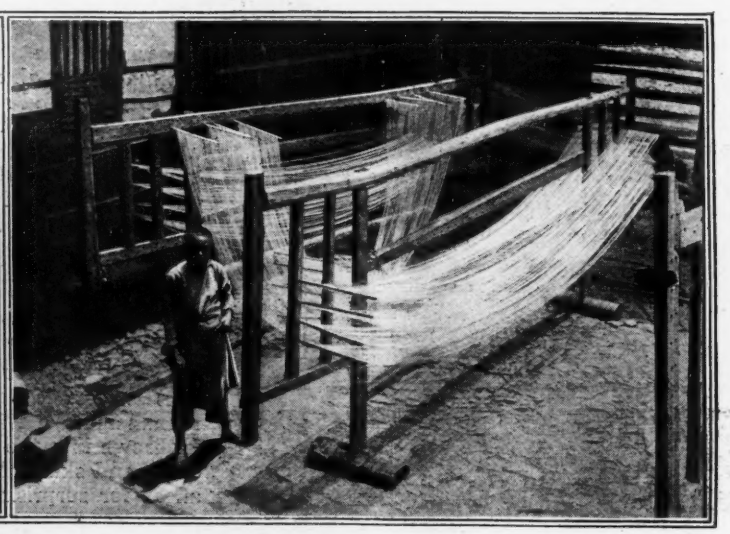
THE Italians made spaghetti famous and the Chinese are helping to keep it so. In many parts of China spaghetti is eaten as much as rice.

The Chinese manufacture it in their own factories, and it is produced in large quantities. Their method of drying the long, thin strands is shown below.

We imagine that they wind it around their chopsticks when they eat it.

Since they can handle rice so deftly, they ought not to have any trouble with spaghetti.





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Taking Chances with a Volcano

STANDING upon a bank of sliding lava to take pictures of a volcano's crater is a daring feat. In Costa Rica, among the turbulent volcanic peaks, is a lake that lies below the level of the highest point of Mt. Poas.

The lake lies in the bed of a crater. During eruptions it sends up hot water, steam, poison gas, and drifting lava.

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Snatching a Lunch on the "Curb"

ON the New York "curb," where fortunes are made and lost nearly every day, the action is so intense that no worker stops long enough to eat. If he grows hungry, he sends for coffee and a sandwich, and swallows them as he telephones or signals to the street.

Traders throng the street, buying and selling. Each transaction is signaled to the watchers in the windows.

Window space is so valuable that windows are partitioned off into "dugouts." There are rows of telephones in each dugout, and as many men as the dugouts will hold.

Visitors to Broad Street, the home of the curb market, are convinced that the operators are quite, quite mad.

© International Film

A Fatal Ride Over Niagara Falls

ILL-FATED was the attempt made by Charles G. Stephens, of Bristol, England, to ride the Horseshoe falls, Niagara, in a barrel. "A cool commercial proposition," he said, before taking the desperate chance.

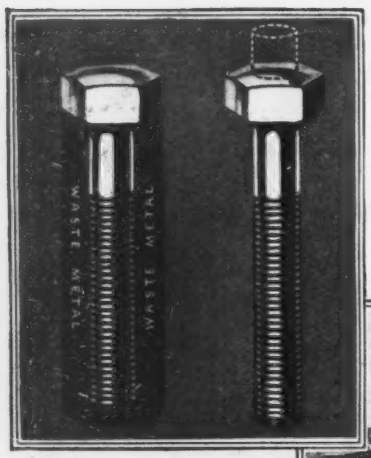
The barrel, instead of riding the surface of the water in its great leap over the brink, evidently dropped upon the rocks below and was dashed to pieces.

Every Man Can Be His Own Cobbler

AS soon as the price of shoes went up, the price of mending them followed close behind. Perhaps it was the high cost of leather or of labor. At any rate, it led to the invention of a new patent sole which any one can attach to his own worn shoes.

The sole needs no sewing or nailing; it is coated with an adhesive waterproof solution, and it is simply glued to the shoe.

"Every man his own cobbler," will be the popular slogan everywhere, and won't parents of large families rejoice and be glad? Although for many moons, now, the shoe has pinched all who are obliged to wear footgear.



A 2000-Year-Old Idea Changed

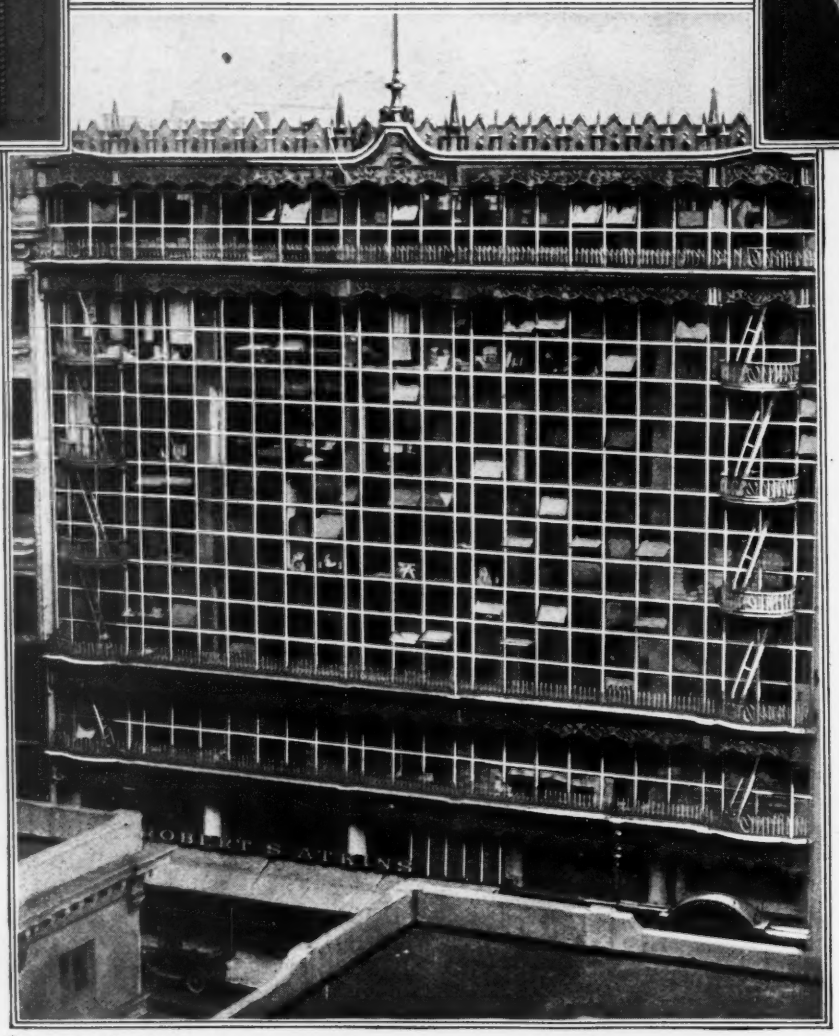
ARCHIMEDES is credited with the invention of the screw. Since 236 B.C. metal screws have been made. The shank of the screw has been turned from a bar of metal having the diameter of the screw-head, literally wasting a large percentage of the metal by reducing it to shavings.

An American screw manufacturer has decided to change this practice. A metal bar the diameter of the shank is put in a matrix and subjected to enormous pressure. The head of the screw is thus expanded in the confined compartment, which gives it the desired shape. The only waste is in threading the screw and finishing the head.

Two thousand years seems a long time to wait for an improvement, though.

People Who Live in Glass Houses

WE'VE heard much about people who live in glass houses, but we never saw any of these glass houses until now. Strictly speaking, people don't live in the glass house to which we refer; they work in it. Some of the people make men's clothes; others sell them. The house is a men's furnishings store. The glass front makes all the floors light and airy. There is little chance that the people within will throw stones; they are too busy.



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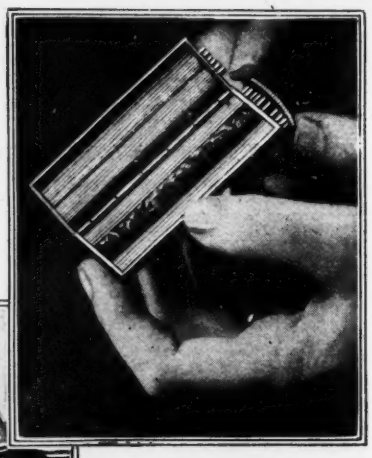


Rolling Your Smokes by Machine

DO you roll your own cigarettes? There is a certain knack in rolling cigarettes that everybody does not possess.

But now we have a new cigarette roller—made in London—that does everything for you but lick the edge.

You pour tobacco into a small trough, close the top and turn a cap at the end, which rolls the tobacco into shape. Next you insert a cigarette paper, and turn the cap. Now your cigarette is rolled and all you have to do is wet the edge. If you fail here, we advise you to smoke ready-made cigarettes.

This neat little invention has somewhat the appearance of a carpet-sweeper, but with its help you can always smoke your favorite brand of tobacco, only found in bags or cans.

Self-Torture Indulged in by the Filipino

A STRANGE-LOOKING creature is this harmless *flagellante* of the Philippines: which being interpreted means a Filipino whose conscience bids him do penance for his sins. A great many Filipinos spend Easter in this fashion.

These penitents hide their faces in a white cloth topped by a circlet of twigs and leaves, probably in emulation of Christ's "crown of thorns." From time to time they bind cords about the body and limbs in order to stop excessive loss of blood.

Thus they wander about, flailing themselves with a bamboo rod, until sunset, when, often covered with blood, they seek a pool in which to bathe.

The custom is no longer permitted in the city of Manila. But on Easter Sunday morning hundreds of penitents leave the city to indulge in this horrible torture for their sins.

© Underwood & Underwood

And Now the Electric Tie-Tamper

THE man you see in the illustration is using a recently perfected electric tie-tamper. Tie-tampers have been used for many years, but they have depended upon compressed air or human energy for their power. There is now, however, an electric tamper. It has but a single moving part, known as the "rotor." The shaft of the rotor revolves at a speed of 3600 revolutions per minute.

The peculiarly constructed handle absorbs all vibration, and the man operating the tamper does not feel it.

Electric power is provided for the tool by means of the ordinary insulated cable. It is connected to the bottom of the motor.

The handle is a reversely crooked spring steel one, and the tamping bar is clamped to the motor. Various tamping tools can be attached.

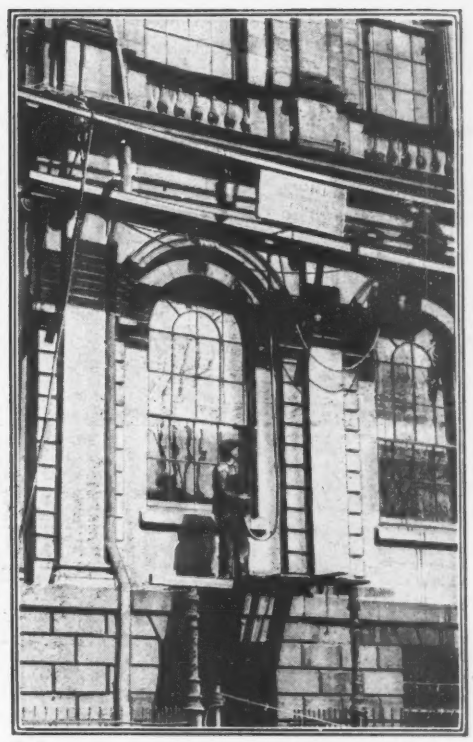
A Flagstaff Made of Fir

IT looks like an oil-well with Great Britain's Union Jack waving in the breeze. But it isn't. It is more curious still. It is a flagstaff one hundred and seventy-five feet high located "somewhere in Australia."

What an inspiring sight it must be to see the Union Jack run up one hundred and seventy-five feet and slowly straighten out in the breeze at that great height.

The flagstaff is made of fir timber, one of the important industries of that vast continent in the far-off south seas.

Some adventurous souls must have had pleasant hours assisting in the construction of this elongated flagstaff. There are many such curious things found all over the earth, appearing to serve no other purpose than to attract sightseers.



It's a Chinese Coffin Chute

TENEMENT houses in China are very much like tenement houses all over the world. The staircases are narrow, dark, winding, and will not accommodate large boxes—coffins, for an instance. Thus you find on many Chinese houses a coffin chute like the one shown above.

Of course, its use is not restricted to coffins, although it was made to accommodate them especially.

An interesting fact about this chute is that it is made entirely without the use of nails or screws. The Chinese often make complete buildings this way.

"Shooting the chute" in a coffin is not an attractive prospect, so the Chinese evidently try to smother this use of their ingenious superstructure by using it as a common stairway.

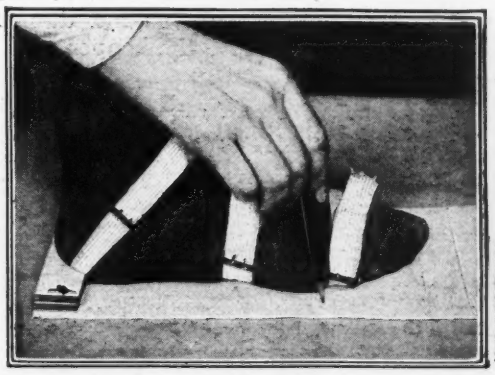
All manner of articles can be carried up and down it with ease. But when the time comes for the chute to be used for its original purpose, the usual lively scene becomes one of solemnity.

Find Out what Size Shoe You Wear

ONE does not need to rely upon the guess of the shoe-clerk to find out what size shoe he should buy. As a matter of actual measurement, the simple device illustrated in the picture below enables one quickly to obtain the right size.

The foot is placed on a card, with the heel far up against the stop at one end. The straps are then buckled over the foot and a line is drawn around the edge with a pencil. When the foot is removed, it is an easy matter to measure the outline and thus ascertain the precise size.

The idea of having straps to fasten around the foot is to provide a safeguard against movement and to furnish a neat outline.



Waterproofing New York's City Hall

WHEN the famous obelisk in Central Park, New York, began to crumble, Professor R. Ogden Doremus invented a waterproofing process that promptly stopped the decay of the stone. Since then his waterproofing process has been used on many public buildings.

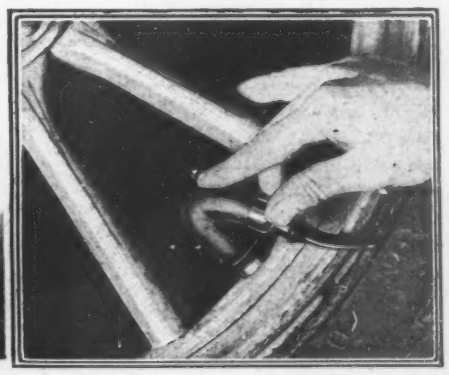
The workmen shown in the picture above are waterproofing New York's old City Hall. Some parts of the stone have become so rotten that an outer layer has dropped off.

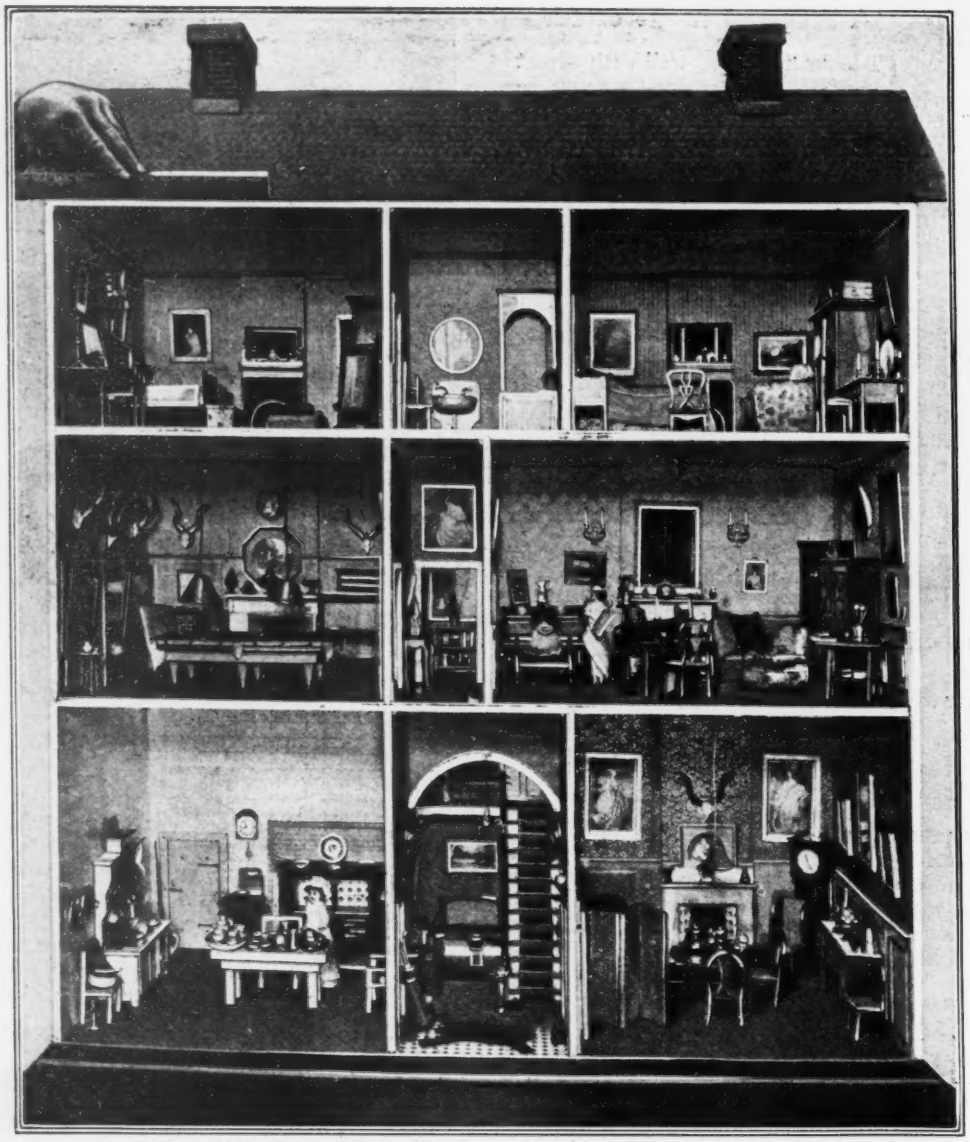
First the stone is heated with a kerosene torch that works under an air pressure of sixty pounds to the square inch. A paraffin-wax solution is next applied to the heated stone, impregnating it to a depth of one-quarter of an inch, sealing the pores, and effectually waterproofing it. The entire building is then washed down with a special cleaning solution which brings the stone back to its original color—the heating process giving it a curious brown and mottled appearance.

Here's a New Way to Clean a Pipe

"JUST a minute, I want to stop and clean my pipe," said the smoker, and he astonished his friend by removing the cap of the valve of a "free air" tube outside the garage. Then he placed the bowl of the pipe over the valve, and, presto! The rush of compressed air blew the pipe clean in a jiffy.

"There is another way that works about as well," he continued. "Take the cap from the valve of your auto tire—or somebody else's. Press the pipe-bowl down on the valve and the air will do the work just as well. But of course, you will have to see that not too much air is allowed to escape, otherwise there will be a little job of pumping."





This doll's house is in the Victoria and Albert Museum, London. It is a faithful copy of an Englishman's home in the early twentieth century

Home Comforts for Dolls

HOW a little girl's heart would thrill with joy if she were the mistress of the perfectly complete doll's house shown here! But it is not for any mere child to play with. This most exceptional toy has been borrowed by that most learned and cultured institute, the Victoria and Albert Museum in London.

Have you noticed the perfection of detail displayed throughout in the furnishings of the house? It is a replica of an early twentieth-century home of an Englishman.

It was built by Major R. S. Hunter Blair of the British Army, between 1914 and 1918. It is said to be worthy of comparison with the best specimens of doll's house construction, and the scale of the furniture and fittings is said to be more accurate than is usual.

Don't overlook the old masters on the walls of the dining-room; also the Chippendale. Upstairs there is the drawing-room and a billiard-room. On the third floor, besides the two bedrooms, there is a bathroom—which would almost lead one to think that this must be a copy of a British nobleman's home instead of that of only a middle-class gentleman.

This machine will clip off the tiny branches from which camphor is made. The camphor bushes are planted in rows and, until this machine was invented, were trimmed by hand. The detail at the right shows how the machine operates

Plucking Camphor Leaves by Machine

VERY few people know that the fluid possessing the invigorating odor of camphor is distilled from leaves, twigs, and branches plucked from cultivated trees.

A machine has been designed by G. A. Russell of the Bureau of Plant Industry, United States Department of Agriculture, that does away with the tedious method of harvesting camphor leaves and twigs by hand. The excessive cost of labor and the injury to the trees from hand-picking had seriously threatened the production of camphor in Florida and other states.

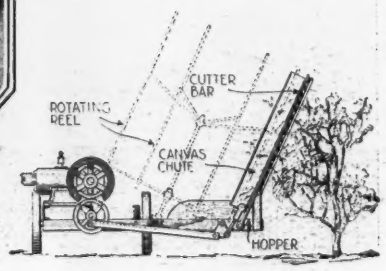
The small branches, rarely exceeding one inch in diameter, are removed and subjected to a distillation process whereby camphor is produced. The trees are grown in rows, and cultivated in the same manner as other crops. Unless care is exercised in trimming the trees, their future usefulness is impaired.

The new camphor-trimming machine is constructed in the following way: An internal-combustion engine, of suitable horsepower capacity, is placed on a truck-frame. The engine furnishes power for driving the cutting knives. The cutting-frame is supported at the right-hand side by an arrangement of leaf and coil springs so fixed to the cutting-frame as to eliminate excess vibration. The rocker arm permits the angle of the cutter-bar to vary from sixty to seventy degrees without dislocating the movement of the cutting knives beyond the center of the guard.

The sickle guards are of cast steel with teeth cut in their edges. The latter serve the purpose of holding the branches of the camphor-tree firmly against the guard while the knife acts as a guillotine.

A reel is used for whipping the leaves and twigs of the camphor-tree into the cutting knives.

A canvas chute, located at the rear of the truck, catches the branches and leaves as they fall. They drop into a moving apron, which conducts them up to and over the side of the machine frame and dumps them into the hopper.

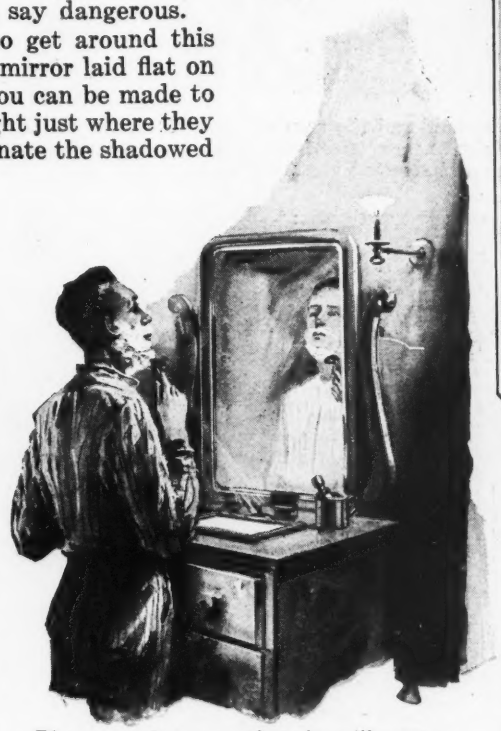


How to Shave by Reflected Light

DID you ever have to shave by a light so high on the wall that no matter how far back you tilted your head, there was always a strong shadow under your chin? Pretty aggravating, not to say dangerous.

There is a way to get around this difficulty. A small mirror laid flat on the dresser before you can be made to reflect the rays of light just where they are needed to illuminate the shadowed side of the face. Your image as seen in the large wall mirror then will be properly lighted for a comfortable shave.

In the absence of an extra mirror any reflecting surface will serve—even the face of the hard-working alarm-clock can be made to serve the purpose, or that handy little trench mirror of polished steel that you took "over there" and brought back.



Place a mirror so that it will cast a reflected light on the shadows of the face

© Keystone View Co.

They're singing for a phonograph record. Behind the horn there is a diaphragm, a lever, a jeweled point and a recording disk

Making a Musical Record

"IT'S kissing time!" shout the fervent four in the picture above, and a jeweled point records the song on a rotating wax disk. This jeweled point is attached to a lever that is connected with a thin glass diaphragm inside the horn into which they shout. Thus is a master phonograph record started on its way.

As the four continue to sing, the jewel traces a long, sinuous spiral groove on the soft wax disk. When the song is sung, the wax disk is removed, carefully wrapped in cotton, and sent to the factory, where it receives an electroplating bath. A coating of copper is deposited on the wax, and when the coat is sufficiently thick it is removed. Several molds are made from this one, and they are all nickel-plated and polished before they are placed on the final pressing-machines.

The stuff that records are made of—shellac, stone, rags—is heated until it becomes plastic. A lump of it is dropped on one of the molds and then squeezed thin in a huge hydraulic press. It works itself into every tiny groove in the mold and hardens as it cools. The edges are then trimmed off and the record is ready for sale.

Hold the finished record to the light and see how the fine grooves split the beams into prismatic colors! So close and fine are the ridges between the grooves that they can produce this effect of diffraction. But just look at a part of this same record under the microscope and note the transformation.

Keeping Smooth Logs from Rolling

LOADING a railroad car or a lumber truck with logs or poles from which the branches and the bark have been removed, is a very difficult and often dangerous task. Such logs are comparatively smooth, and when they are piled up in stacks, they have a tendency to roll off, causing the whole stack to slip and roll, and endangering the workmen engaged in loading. Even the use of wedges and bracing-blocks does not always prevent accidents.

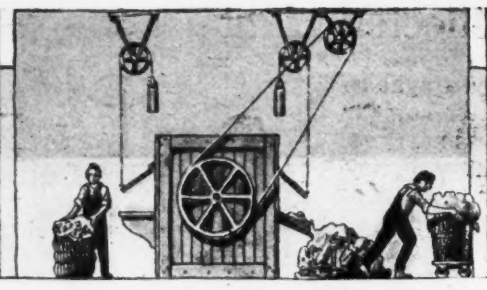
The jointed side stakes shown in the illustration below are a German invention which makes it possible to load long logs, telegraph-poles, etc., quickly and without danger to the workmen. They may be used with equal success for railway cars or lumber trucks.

The logs rest on heavy iron cross girders to the ends of which the jointed side stakes are bolted. Each stake consists of two or three link bars of iron loosely jointed together by bolts, somewhat like the sections of a folding foot-rule. When a car is to be loaded with logs, the first link bar is swung to a vertical position and rigidly locked by a pin passing through the two upright parts of the double girder and the side stake.

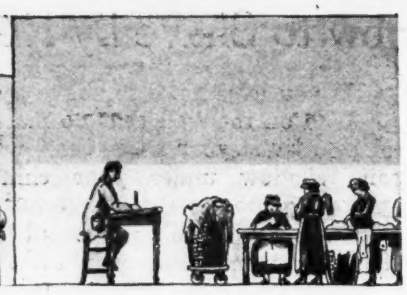
As the loading progresses, the second and then the third links are locked in position. After the car or truck is loaded, the ends of each set of stakes are fastened together.

The folded links of the side stakes are extended and locked in position as the loading progresses

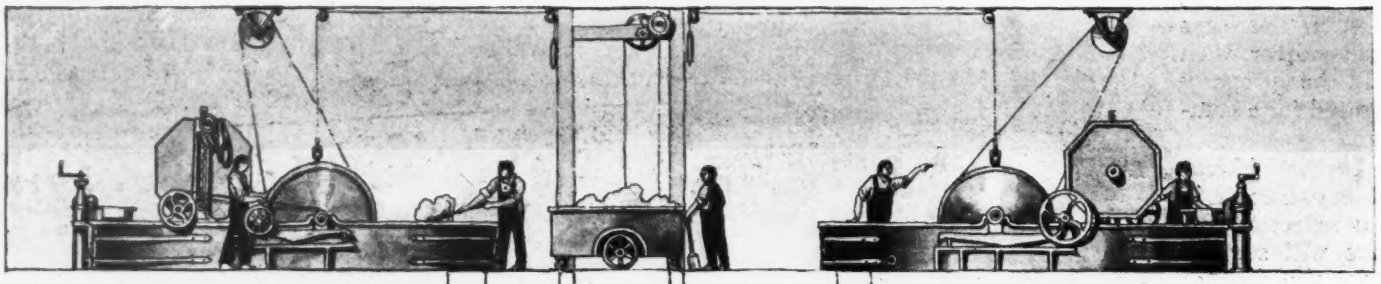
1. The rags are brought to the paper-mill in bales. Preferably they are clean rags, picked up from factory floors



2. The bales are opened and the rags are put through what is known as a "thrasher," which separates them and removes the loose dirt

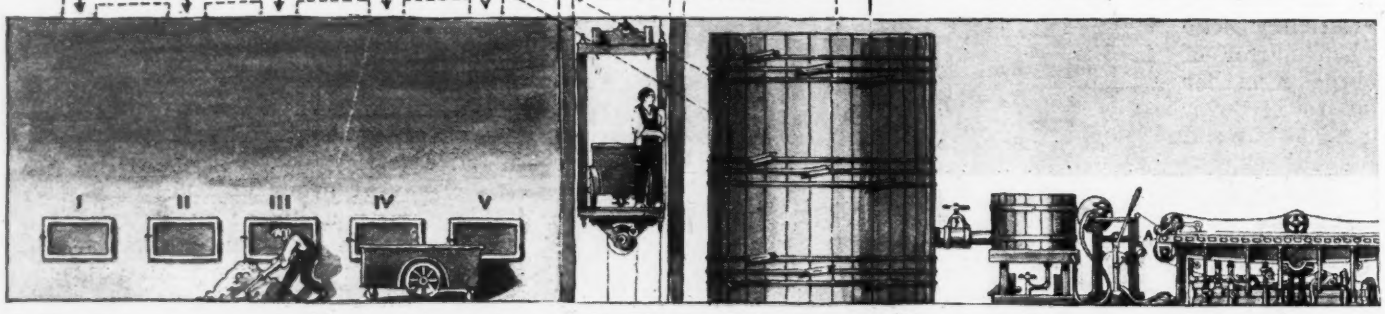


3. Then to the "sorting room," where women throw out the old rags and all foreign matter



9a. In the "beaters" the actual pulp-making takes place. Various grades of "half stuff" are mixed and beaten, the pulp going into the "stuff chest"

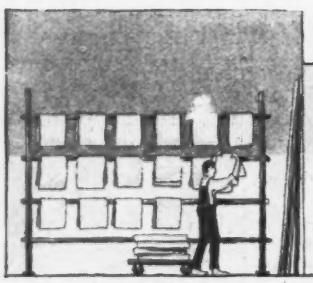
9b. Where several grades of material are used and when coloring is added, the "beating" must be well done or the finished product would emerge unevenly colored and graded



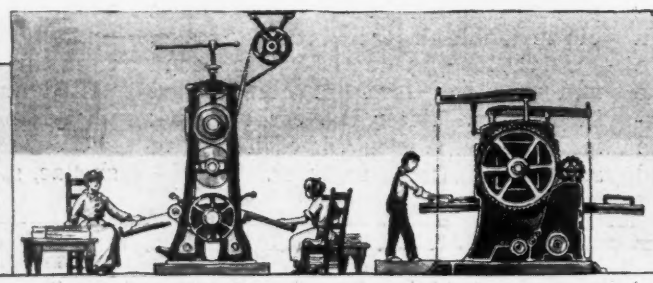
8. The drainers exhaust the bleach, which drains through the bottom. The rags are now "half stuff" being loaded in cars and lifted to the "beaters"

10. The "stuff chest" is a tank where a paddle keeps the fibers mixed with water

11. Through a "flow box" the pulp is pumped to the paper-making machine (*A*)



13. In the "loft," in a temperature of 120°, the sheets are hung up to dry



14. The "calender stack" consists of steel and cotton rolls which iron the paper

15. When a glazed or linen finish is desired, a "plating machine" is used

16. Then the sheets are squared and cut with the "trimming knife"

A Look into a Paper-Mill—

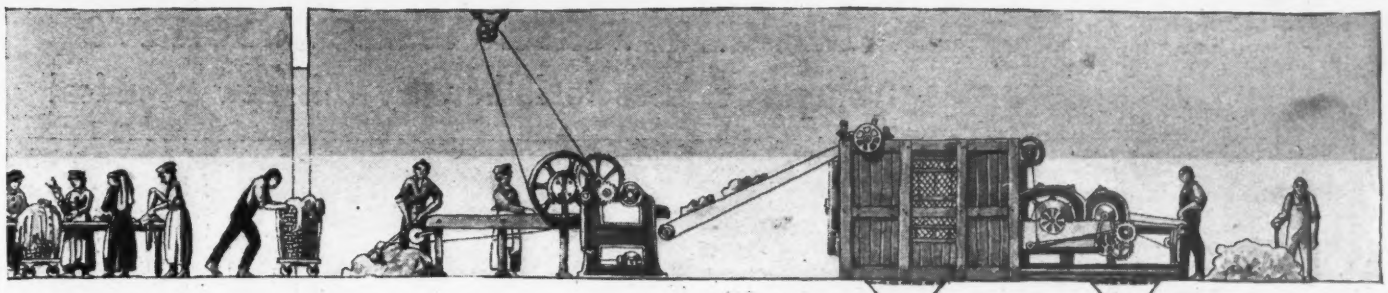
It's a far cry from papyrus

THE man who first scratched upon a stone or the wall of a cave the sign or the picture that meant something to his fellow savages, started the market for paper. He established a means of understanding, crude but intelligible; and, once started, the desire of mankind to communicate its thought by writing extended the breadth and width of our planet. Can you imagine what the world would be to-day without books, newspapers, or even written manuscripts?

To the plant world we owe the possibility of making paper. It is the walls of plant-cells, the cellulose, that furnishes the important base of all paper-making. From wood, rags, grass, straw, and even experimentally from dead leaves, can be converted the many grades of material upon which we print or write our thoughts.

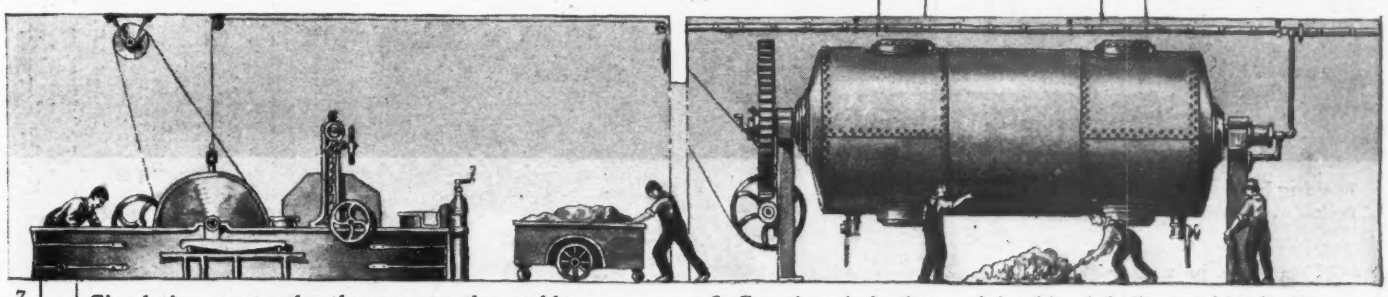
Long ago the Chinese, Egyptians, and Greeks discovered this secret of nature. The Chinese were the first to make paper from rags, while later the Egyptians discovered that they could grind up the papyrus and convert it into material upon which they could transcribe their messages.

We bring out of the wood, the grass, the straw, and the rags, the cellulose fiber in its purest state. The cellulose contains gluten, lignin, and silicon in chemical forms, which must be removed. Both mechanical and chemical processes are involved in this necessary work, and the raw material must be shredded and reduced to its fibrous state while the foreign



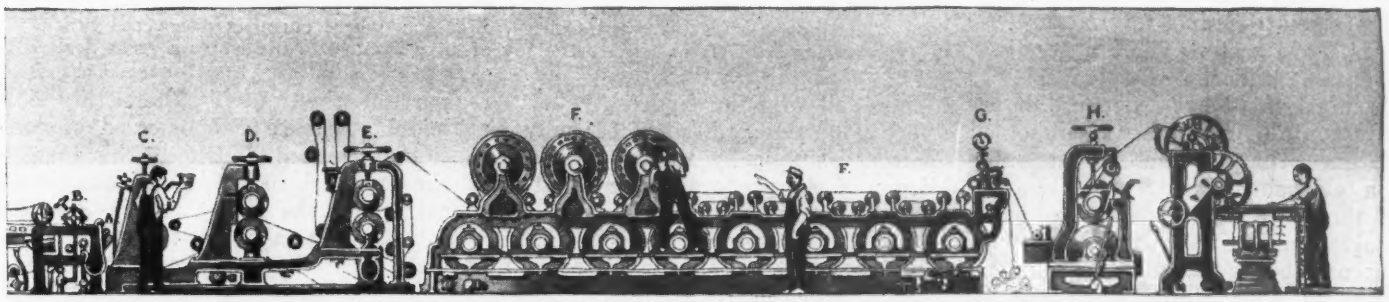
4. Then the rags are cut into strips by hand by the women

5. These strips are fed to machines which cut the rags into bits. The rags are carried on a traveling belt to a "duster." Here the remaining loose dirt is removed and the rags are dumped through a trap admitting them to the revolving "bleach boiler" below

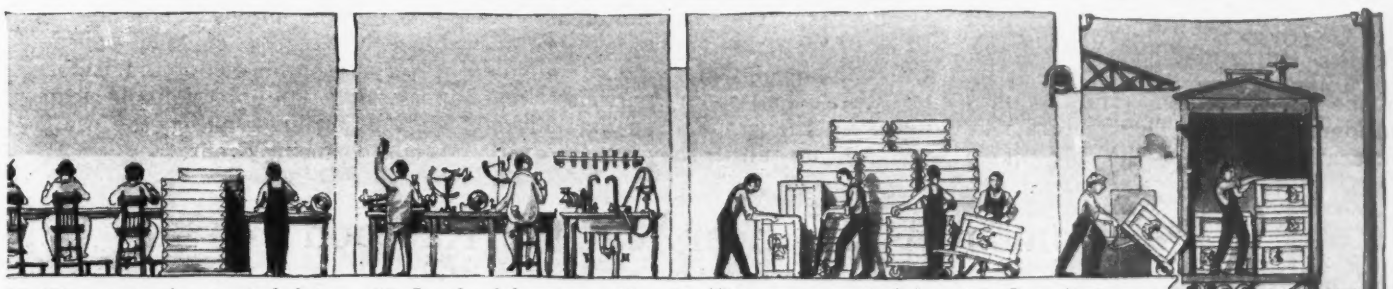


7. Circulating constantly, the rags are thoroughly washed. The bleaching material is added, and the clean rags are emptied into the "drainers"

6. Caustic soda in the revolving bleach boiler combined with a moderate steam pressure loosens the very last vestige of dirt remaining in the rags. Then the rags go to the "washer"



12. The water drains through (*A*), the fiber remaining and forming the sheet, which passes under the "dandy roll" (*B*), pressing the water-mark. A traveling felt carries the web of paper through couch rolls (*C*), and forward rolls (*D*), and reverse rolls (*E*) to the driers (*F*). At the end are the cutters (*G*) and the size-tub (*H*). The paper is then cut



17. The paper is counted into reams, and the defective and perfect sheets are separated

18. In the laboratory all finished paper is tested before it is shipped

19. The reams packed in cases. They are trade-marked before shipping

20. One plant uses twenty freight-cars every day

from Rags to Finished Paper

to machine-made paper

substances are completely removed.

We see in the above illustrations the various stages in the process of paper-making: how the rags are cleaned—literally laundered; how they are shredded in the beaters—"The paper is made in the beaters," is a saying based upon the fact that the properties of any paper are determined by the treatment in the process of beating during the first hour and a half.

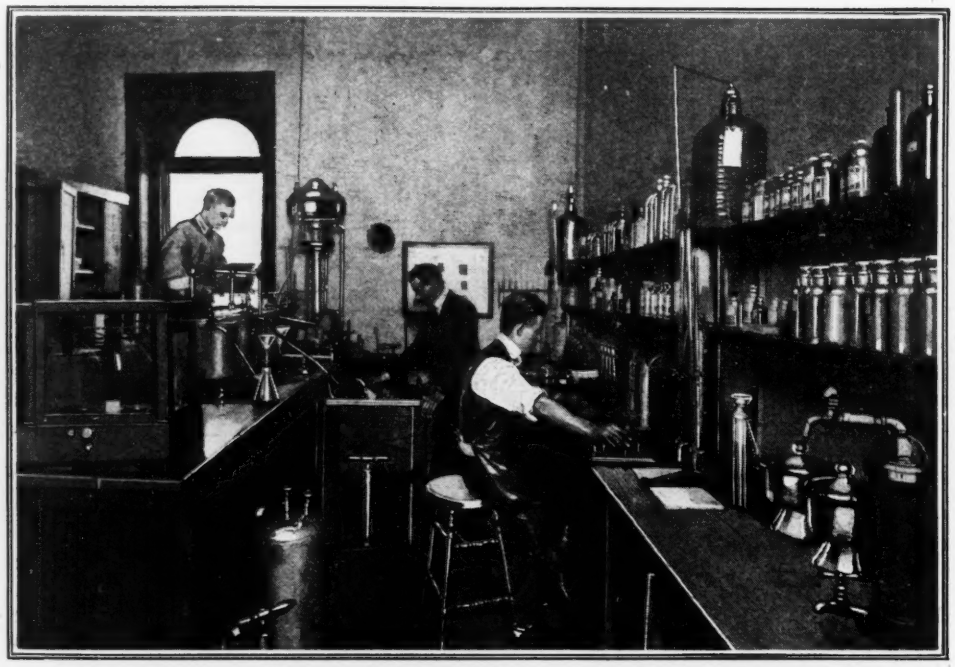
Different varieties of fiber demand different treatment to produce a certain grade of paper. Chemicals are added during the process of beating which give the desired quality. Coloring matter is also added, as also is the "size" that determines the degree of absorption to ink that the finished product will possess. The size is composed of some form of animal or vegetable matter. If the paper is to be "soft glazed," loading material such as china, clay, kaolin, or sulphate of lime is added. Beating with the mixtures of size, color, and fillers makes up the first half of the process of making paper.

Not the least interesting part of the process is the conversion of this mass of wet, masticated material into the finished sheet of paper. The Foudrinier machine does this to perfection. Milky pulp enters at one end and comes out an endless sheet of paper at the other. To this state of development has the invention and skill of man brought the feeble beginning which some writers have traced back to China as early as the second century before Christ.

Making Hard Water Behave

When it refuses to lather, try this new chemical

Making hard water soft with colloidal organic hydrosol



The laboratory at Howard College, Alabama, where chemists discovered how to make hard water soft, to the joy of all who have to use water a great deal

HARD water is water that is not gentle mannered. For instance, it seriously objects to aid in making lather from soap, and for this reason its cleansing value is greatly reduced. In other words, hard water is not a good solvent—it will not dissolve soluble matter. Why? Because it already contains a number of dissolved substances that subtract from its value as a cleansing agent. It might be said that hard water is so full of other dissolved matter that there is no room to accommodate more. The dissolved matter in hard water is mineral in nature, being compounds of calcium, magnesium, and iron.

To make hard water soft, it becomes necessary to remove all dissolved matter so that the water will be able to take up more. This process is by no means convenient and requires considerable time. Thanks to a new preparation with a difficult name (colloidal organic hydrosol) but a very good effect, hard water may be softened simply by adding a very few drops of the preparation, without the removal of the dissolved matter. This hydrosol, which really means *water-soluble*, has been prepared by Dr. I. Newton Kugelmass, professor of chemistry at Howard College, Birmingham, Alabama.

When Dr. Kugelmass' preparation is added to water, it thoroughly diffuses or disperses throughout the entire volume of water. The colloidal or ultra-microscopic particles that make up the preparation dart hither and thither until they reach every part of the water. These tiny colloidal particles are possessed of considerable energy. Due to this energy, the colloidal particles are capable of attracting the molecules of the dissolved minerals to their surfaces. They are like little policemen that scurry forth to arrest all the idle mineral particles in the water, and a single one of them is capable of making thousands of arrests.

When the mineral molecules combine with the tiny colloidal policemen, a very insoluble compound is formed possessing no objectionable features and aiding in making the water a better cleansing agent.

Combining the Bear and the Raccoon

IF you were an explorer in the wilderness of the mountains of Moupin, eastern Tibet, you might stand one chance in many thousand of being suddenly confronted by a giant panda. If you are a visitor to the American Museum of Natural History, New York City, you will be sure to see one if you look for it. It is believed to be the only specimen of its kind ever brought to this country.

The giant panda in general resembles the shape of a bear and is about the size of our black bear, but it is really a distant cousin of the raccoon. One of the rarest animals, almost nothing is known about its habits, but it is said to feed on roots, vegetables, and bamboo-shoots. It is a striking study in black and white.

A short muzzle and a white face spotted with black around its eyes gives the panda a most ludicrous expression.

Pere David, the French missionary and explorer, discovered the extraordinary animal in Tibet in 1869. Because it bears a resemblance to the bear and the raccoon, the giant panda is also known as the bear-raccoon.

Zoologists reverently refer to this rare beast as the "giant panda." Its more popular cognomen is the "bear-raccoon." Its habitat is Tibet

Telegraphing with Invisible Rays of Heat

How engineers in the French army made use of infra-red rays for secret communications

By John Stuart

JUST as one may signal in a dot-and-dash code by snapping a light on and off, so one may telegraph with heat rays. For secret signaling in war the latter system has a decided advantage. How the engineers of the French army accomplished heat-ray telegraphy may be seen from the accompanying illustrations of their apparatus.

Heat rays from the sun or from a lamp behave exactly as do light rays. Both travel with enormous velocity in straight lines, and are reflected and absorbed by objects that they strike.

In transmitting signals with heat rays, an intense source of heat means a greater range of distance. But light waves always accompany intense heat, so that at the transmitting station a screen must be interposed between the source and the distant receiving apparatus. Black manganese-dioxide glass will cut out the visible light rays and let the infra-red rays through.

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The mechanical heat-ray receptor in use. The heat-rays are focused by a parabolic reflector on to a horn, the interior of which is covered with lampblack

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The heat-ray transmitter in operation. All visible rays are screened off with an opaque shutter. Only the heat or infra-red rays are allowed to escape

Transmitter Is a Searchlight

For a transmitter a searchlight is used, as shown in the illustration. An electric-bulb lamp, which can be run on a small portable battery, is used in the small power transmitter shown. For distances between three and eight miles, higher-powered searchlights of larger diameter are required. These usually operate with an arc-light. Since the heat rays are invisible, a small telescope or sight tube like that shown must be used to point the light toward the receiver. When properly directed, a signal is sent with a key controlling the lamp current, just as in ordinary telegraphy.

© Publishers Photo Service

The heat-ray detector on the extreme right receives messages. The reception is made ultra-sensitive by using a three-stage audion amplifier

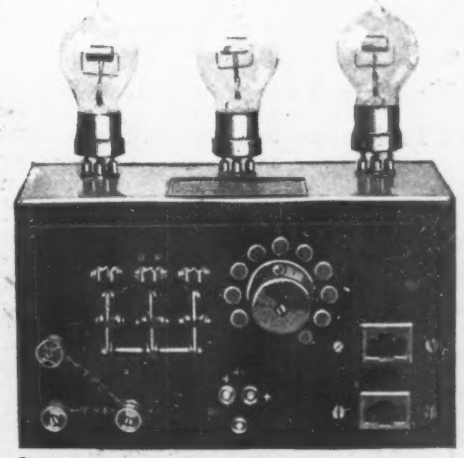
The receiver is a parabolic mirror like that of the searchlight transmitter. At the focus of the mirror is placed a device that is sensitive to heat. In the audible form, this heat detector is a small horn lined with lampblack, which absorbs the heat directed to it by the mirror. The horn is connected to the ears of the listener by a stethoscope-tube. When the signal is being received, the heated lampblack heats the air in the tube, which thereupon expands. When the signal ceases, it cools again. Such alternate expansions and contractions are interpreted by the observer as the beginning and end of dot-and-dash signals, just as does the trained telegrapher with the clicks of a sounder.

Another Receiving System

A more sensitive receiving system was devised by Herbert Stevens and Larigaldie, of the French army. They used a tiny thermoelectric couple which is formed by a fine contact point of platinum with a crystal of tellurium. This is enclosed in a small glass cell with a fluorite window. The heat is brought to a focus exactly on the contact. There results an electromotive force in any circuit to which the other ends of the platinum and tellurium are connected. But this electromotive force is very feeble, so that the wires leading from the cell are connected to a cabinet of vacuum-tube amplifiers. These boost the feeble current until it is sufficient to give a good response in the telephone receivers.

Between the thermocouple and the amplifiers the inventors inserted another cabinet. In addition to containing some auxiliary apparatus for insuring the best adjustment for the given detector, this cabinet contains an interrupter. This makes and breaks the circuit of the thermocouple so many times a second that when any current is flowing, the listener hears a tone in the receivers.

The interrupter is of the hammer type and operates from its own battery. It carries an extra contact point which is used to control the circuit of the heat detector.



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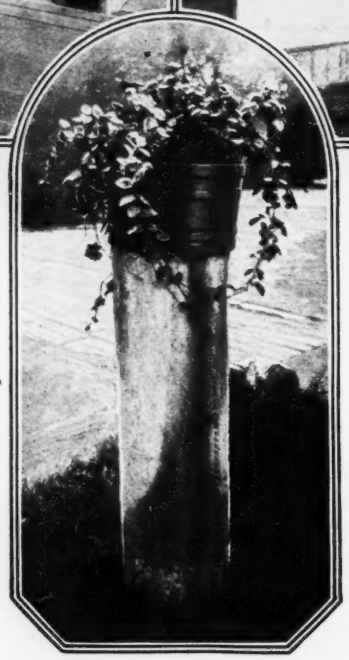
The three-stage audion amplifier used in the reception of the heat-ray messages. The method of reception is very similar to ordinary wireless reception

September, 1920



A Swiveled-Arm Micrometer

"A SWIVELED arm," developed by the United States Bureau of Standards, is an important factor in holding micrometers for measuring pitched diameters of screw threads.

And in the production of thread gages the mechanical swivel arm also supplies a third hand for the operator.

Formerly, in testing screw-threads, a rigid mechanical arm was used. It held the micrometer rigidly, with the faces parallel to the axis of the gage, necessitating the use of two wires. The three-wire method of measuring screw-threads is preferable.

This is made possible by the swivel arm leaving the micrometer free in taking up its position with its faces parallel to the gage axis.

Dyeing Takes a Long Time in Costa Rica

ON the coast of Costa Rica, near Cocos bay, the juice of a certain shell-fish, which abounds there, is used for dyeing.

The process is laborious, since only a small amount of the liquid dye can be obtained from each fish. The way this is done is by blowing one's breath into the shell, whereupon a few drops of a greenish liquid ooze out. This is collected in a clam-shell, and the thread to be dyed is drawn through it.

Exposure to the sunlight turns the color into a rich purple that is absolutely fast in quality.

Making a Boiler into a Pedestal

TAKE your worn-out boiler into the garden and dig a hole. Plant the boiler, and then place a tub of flowers on top of it. The boiler now becomes a pedestal.

If you don't like its appearance, paint it to suit yourself. Except for the beading down the side, the boiler will have lost all trace of its original calling.

The Postman in the Grotto

HOW would you like to earn your daily bread in a beautiful grotto? Such is the lot of an Austrian postman. His post-office is located in the famous Adelsberger grotto and is well within the entrance.

As the light shines on the stalactite formations a beautiful rainbow effect is produced.

It must be admitted that most people who visit the grotto do not go there to see the postman, but the fame of this particular grotto being widespread, he suffers not at all from loneliness. He may even prosper on the generosity of the numerous sightseers to his beautiful home. It is quite reasonable to suppose that he has many incidents of interest to tell them.

The Adelsberger grotto is one of the largest and most magnificent grottos in Europe. It is more than a mile long and is divided into four sections. The river Poik enters the cavern about sixty feet from the entrance, and the murmur of it can be heard throughout.

Planting Telegraph Poles with a Tractor

IT so happens that telegraph-poles must often be planted in out-of-the-way places. Therefore the new combination tractor and boring-machine, shown at the right, is very useful to pole-planters.

The caterpillar wheels enable the machine to climb with ease over rough places. Then, when the site of the new pole is reached, the power is switched to the earth-boring end of the machine.

The auger will bore a hole in the ground of any size from two to thirty inches and as deep as eight feet. After the hole is bored, the steel tower that holds the auger lifts the telegraph-pole and puts it in place.

It is interesting to note that the time occupied in digging the hole for the pole and setting it up is only about eight minutes.

The Smallest Phonograph

CHILDREN can make as much noise as grown-ups, and so can little phonographs. Here is one that weighs but four pounds, yet when wound it is ready to pour forth Caruso at his loudest. The secret of this tiny phonograph is a double-action spring that takes the place of the usual motor.

You wind it by means of a handle. When you release the turntable it will revolve until the spring runs down.

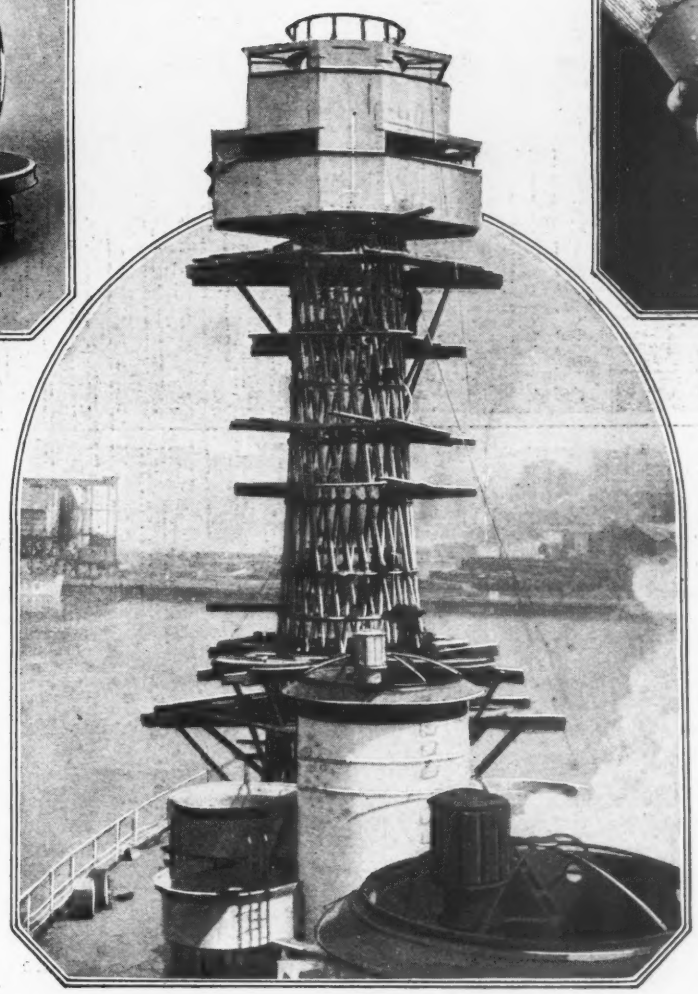
The turntable will hold a ten-inch record. There are tone and speed controls on this small machine, just as there are on the large ones.

Whisky *alias* Timber

THINGS are not always what they seem. In the earliest days of prohibition in the United States a most respectable-looking carload of wood was torn apart by an inquisitive revenue agent, and inside he found cases and cases of whisky.

That smuggler had enclosed six hundred cases in two layers of timber. Just how it was discovered we do not know. Perhaps the whisky was so strong that the revenue man just naturally got wind of it.

This is only one of the methods of smuggling whisky. A very large book could be written now on the various means employed since prohibition came into force. The method shown is a good one, but it is not nearly as clever as others that have been used.



Directing Hits from the Top

OUR latest dreadnought, the *Tennessee*, is one of the largest war-ships afloat.

The vessel is somewhat different from other vessels of her type. Instead of having her boilers grouped under one four-sectioned funnel, they are distributed over a wider area and protected with additional horizontal armor.

Our naval constructors, profiting by the lessons of the war, have placed the controls of the director firing system far above the scene of big gun hits, on the top of the cage-masts.

Notice the double-section funnel in the foreground.

One half of this type of funnel could be shot away and the other half would still be able to do the work of both.

A Confetti Explosion

"BOOM!" A loud explosion in the midst of the crowd of hilarious people celebrating the election or a holiday. Colored confetti bursts forth, and flutters in the air, falling upon the merry-makers.

The confetti "bomb" is a recent invention. It consists of a cardboard cylinder having a small compartment in the bottom of which a charge of explosive mixture has been placed.

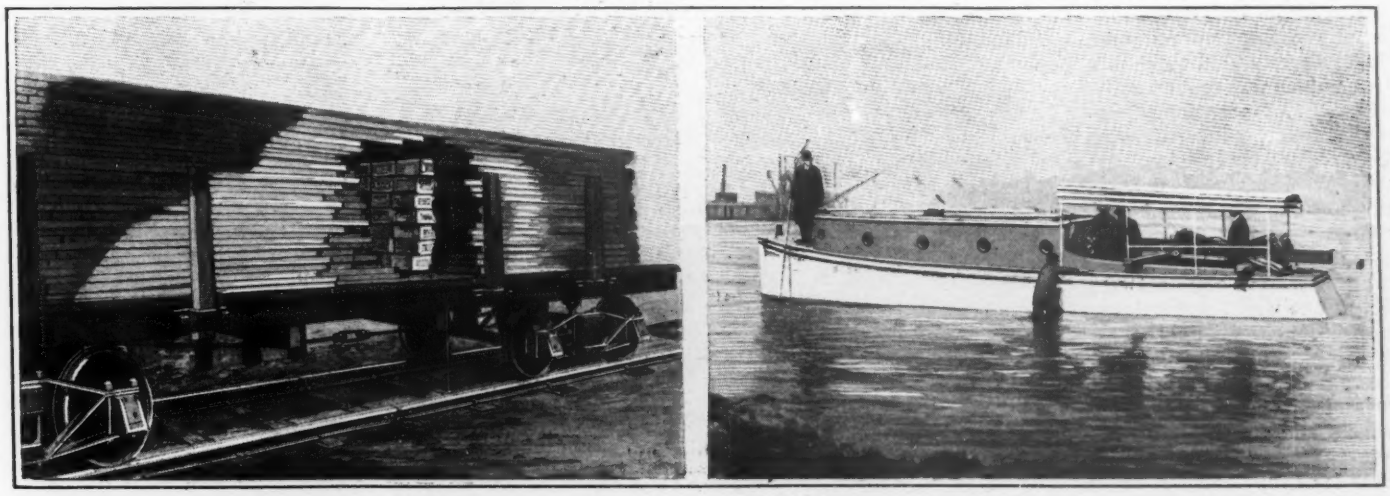
The upper part of the cylinder is filled with confetti or any light material one may wish to blow into the air.

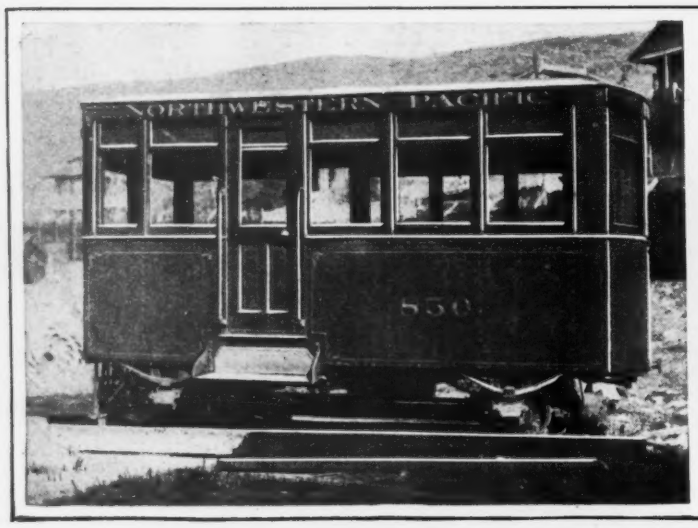
A Shallow-Water Boat

HERE'S a little boat of the "ankle deep" type. It can float in fifteen inches of water. With such a slight draft it can navigate shallow streams where other boats of its size dare not go.

The vacuum tunnel method of boat construction was applied to this boat. This enables it to reach practically any place that is accessible to rowboats or canoes. For a boat of this type there are seventy thousand miles of waterways in the United States.

Many pleasant trips must be foregone with ordinary boats merely because they cannot navigate shallow streams where the scenery may be very beautiful. This type of boat is no more costly than boats of ordinary construction.





Rapid Transit with an Automobile Engine

A NEW use for an automobile engine has been found by enterprising officials of the Northwestern Pacific Railroad.

Hand-cars and power-driven cars are the ordinary conveyances for rapid transit over the rail systems where inspection or repair work is required. But the exposed "flat-car" is far less inviting in disagreeable weather than the little car equipped with an engine from an old automobile.

This covered miniature passenger coach will seat ten persons, and it skims along the track as rapidly as a train. It is provided with an air-brake, but otherwise its operation is exactly like that of an automobile.

"Honk! Honk!" is the familiar exclamation of the road automobile when a warning is sounded with its horn. The sound of an auto horn would startle people if it proceeded from a railroad car traveling on a track.

Fisherwomen of Belgium

THESE are not hard-working Indian squaws. They are Belgian peasants fishing in an unusual way.

The poles they hold are about ten feet long. The nets nailed to the horizontal bar sweep down to a great length and are caught up like a pocket, forming a hollow in which to hold the fish.

Baskets for the deposit of the contemplated catch are slung over the women's backs and arms. Dressed in old clothes they wade into the water and with a sweeping swing of the long pole and a flourish of the nets, cast for fisherwomen's luck.

Evidently Belgium is not backward in giving its women equal rights with its men to do hard work.

Sick People Cured by Compressed Air

YEARS ago, when you were ill, the doctor ordered pills. Now he may order anything from electricity to compressed air; from an operation to a faith ure.

Dr. O. G. Cunningham, of Kansas City, Missouri, is the first man to invent a compressed-air tunnel for his patients. This tunnel is made of steel, and is eighty-eight feet long and ten feet in diameter. Inside there are seats to accommodate seventy-two patients. An air-pressure of from five to twenty pounds to the square inch, depending on the condition of the patient, is applied.

This treatment is said to cause an improvement in blood circulation and as a result quiets the patient's nerves. He is able to sleep well and his appetite improves.

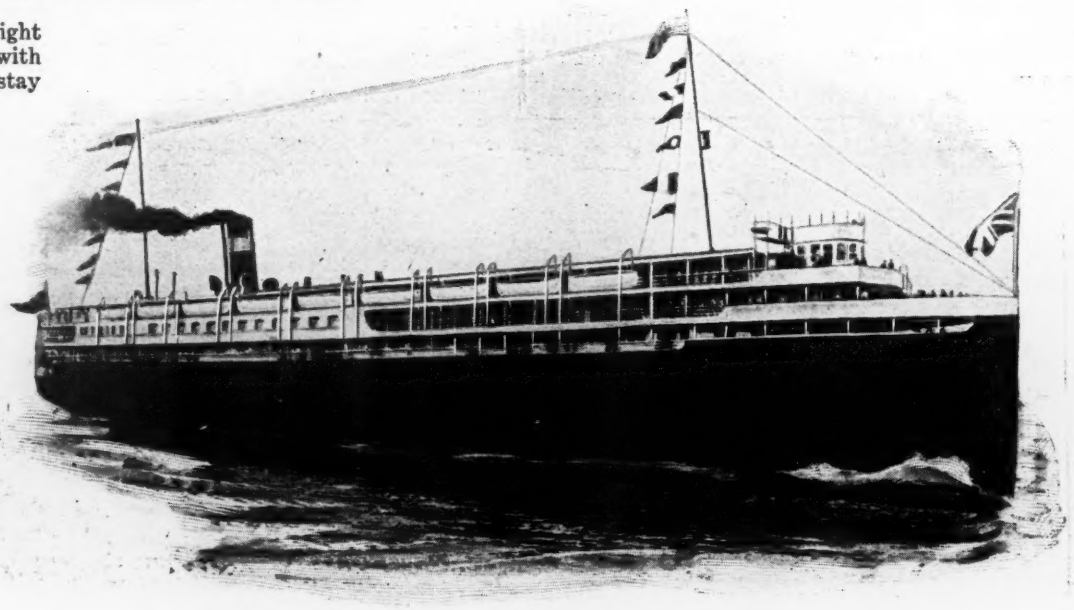
Compressed-air treatment is particularly good for rheumatism, heart disease, high blood-pressure, gout, paralysis, and other diseases arising from poor blood condition.

A Floating Hotel Relieves Shortage of Homes

TO distinguish this hotel one might say that it is not connected with the dry land. It is designed to stay on the water in Lake Erie and will be in use near Detroit.

To relieve the crowded city and the scarcity of hotels this floating palace will prove vastly beneficial. All comforts, including meals, etc., will be served on board this boat, which in fact is the flagship of a fleet of floating hotels. These boats are to remain moored near the city until the overcrowding of the land hotels has ameliorated.

To any one who has lived for a week or longer on an ocean-going vessel, this novel hotel will have a very strong appeal. There is a friendliness among the passengers and a community of interest that would be impossible on land.



Water-Wings for the Airplane

WHEN Harry Hawker was forced to land his airplane in mid-ocean, he knew that if he weren't rescued immediately he would drown. His airplane not having been built for floating.

But now there are air-bags with which an airplane can be equipped when it starts on a trip over water. The bags are placed on the under side of the wings, close to the propeller. If the airplane begins to fall, the pilot can blow up the bags. Then, when the airplane hits the water, it will float as if it were a hydroplane.

Recently an airplane equipped with these air-bags was lost during fleet maneuvers at Guantanamo. It had been floating for forty-eight hours when it was picked up.

Riding in the air is continually being made safer by innumerable inventions, and soon we shall not hesitate to trust ourselves to the mercy of any airman who hails us. Over land or sea we shall sail with equal nonchalance.

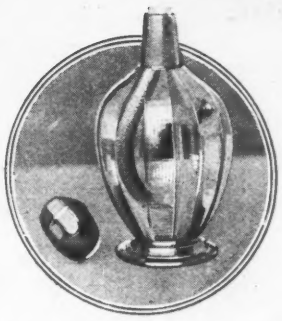
© Keystone View Co.

Five Little Pigs Go Riding

THIS little pig—the one shown above—went to market in a very modern motorcycle truck. So did several of his brothers and sisters. Thus the farmer who owned them saved the price of a middleman.

Surely one way to cut down prices is to reduce the number of people who make a profit on each transaction that takes place in order to get the product from the producer to the consumer. The farmer gets a higher price for his pigs, and the buyer doesn't have to pay so much for them, when there is no middleman to reckon with.

The truck motorcycle is an outgrowth of the side-car motorcycle, and one can imagine that they will become very popular with small farmers, in fact with all dealers who have only a small circuit to cover in their particular business.



A Vase that Swallows Smoke

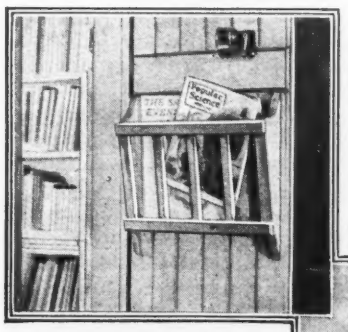
IF, while calling on a friend, you should notice a strange blue vase, with a wick coiled up inside, standing on a table, don't be alarmed. That wick was put there with the purpose of luring cigarette smoke into the vase. To use the vase, remove the cap and light the wick. Instead of making more smoke, the lighted wick mysteriously absorbs the smoke in the room.

Along Come the Hosts of "Molly-Mawks"

THERE are more than one hundred species of petrels scattered in widespread areas of ocean, but among the most interesting are the fulmars. Sailors of British vessels commonly refer to them as "molly-mawks," a corruption of mallemuck. The birds in great flocks follow in the wake of ships, and are specially fond of a whaling vessel, for they like the oily substance that is thrown out in the refuse from whale-cleaning.

The fulmar ranges over the North Atlantic from 45° latitude on the American side, and lower, to 53° as the farthest south, on the European side.

© Int. Film



Here's a Place for the Magazines

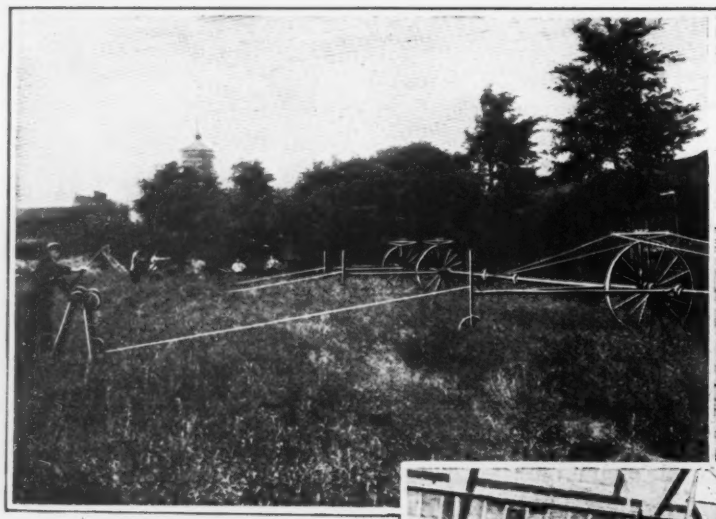
INSTEAD of having the magazines scattered helter-skelter all over the place, why not hang them on the wall?

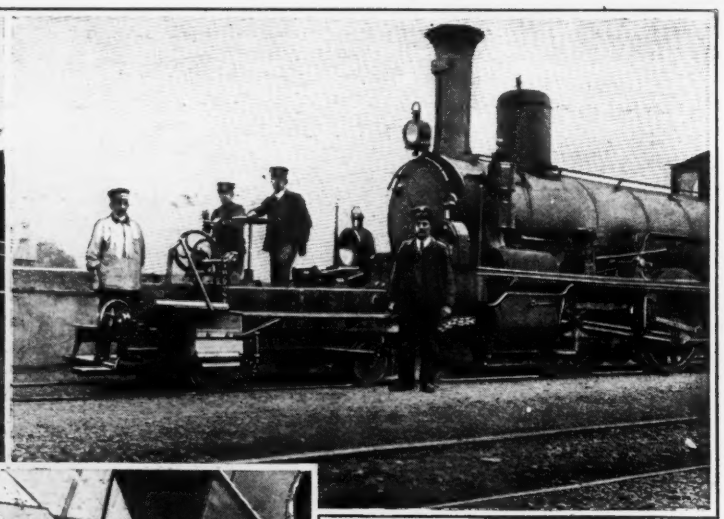
A holder can be made by a plain wooden rack attached to the wall of one's den. It is fixed at a suitable distance from the floor so that even the shortest person can reach it. The top of the rack tilts forward and is wide enough to provide plenty of room for the magazines. One can thus move them easily without taking them out of the rack.

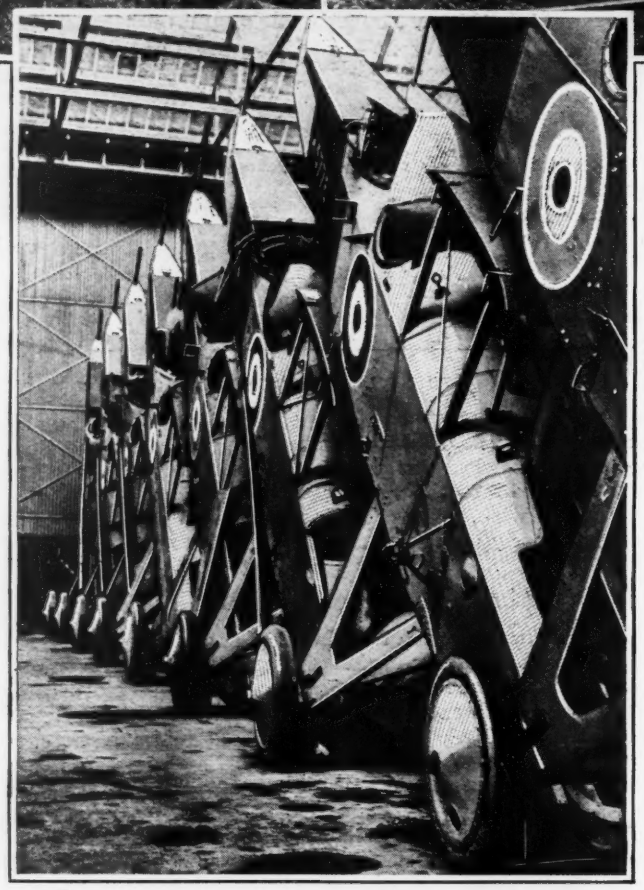
A Combination Pen-Pencil

PERHAPS you carry a fountain pen and a pencil in your coat pocket, as is the custom of the American business man.

Why not combine the two and carry them as one? Just such a fountain-pen-pencil is shown herewith. The ink cavity extends to about the center and then a wall divides it from the pencil section. There is one cap and it is placed over the pen end. Of course you must tuck it away lead end first to prevent the pen leaking.







When there Is a Drought in Germany

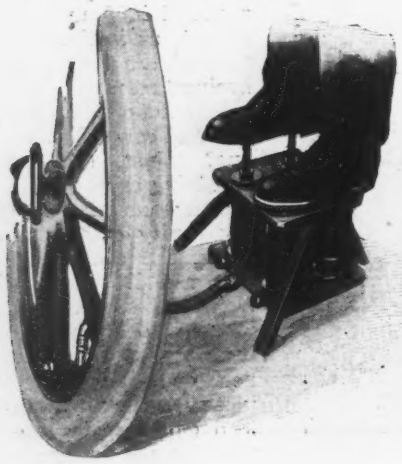
WHEN it fails to rain in Germany, farmers get out strange, complicated watering devices—like the one shown above—and sprinkle the ground. In this picture the men are shown winding up cables attached to the sprinklers, thereby drawing them across the field.

A centrifugal pump supplies water to the various sprinklers, which are attached to one long feed-pipe. Practically any number of sprinklers can be used at one time; thus a whole field can be watered in a very short time.

Pumping Your Tires with Your Foot

NOW comes an inventor with a foot-pump to make pumping easy. It is far less painful to work a foot up and down than to distort the whole body in pumping an automobile or a bicycle tire. Charles G. Lillos, of Minneapolis, invented this pump.

The new air-pump is composed of two foot-treads and two, or four, cylinders. The operator stands upon the treads, alternately lifting one foot, then the other. The work of inflating a large tire is accomplished with far less strain than when using the ordinary air-pump.



Airplanes by Wholesale or Retail

IF you wish to buy an airplane, here's a chance to get one cheap. England has decided to sell more than ten thousand machines, many of them world-war veterans and all of them said to be in excellent condition.

The airplanes for sale are stacked up as if they were so many brooms, one against the other. Yet it was not so long ago that an airplane was a rare object, with a private hangar all its own. You were exceedingly lucky if you chanced to see one. And now you can buy them by the dozen!

England is also selling airplane engines—thirty thousand of them—that have been salvaged from wrecked airplanes from time to time.

An airplane is not a bad investment.

If you take up passengers and charge them at the rate of a dollar a minute, you will soon have your airplane paid for. All you need to do is rent a landing-field, hire a pilot, and get the proper permits.

This Train Cuts Weeds as It Travels

BETWEEN railroad ties appears to be most fertile ground for weeds. It is too expensive, however, to have a gang of men remove them by hand.

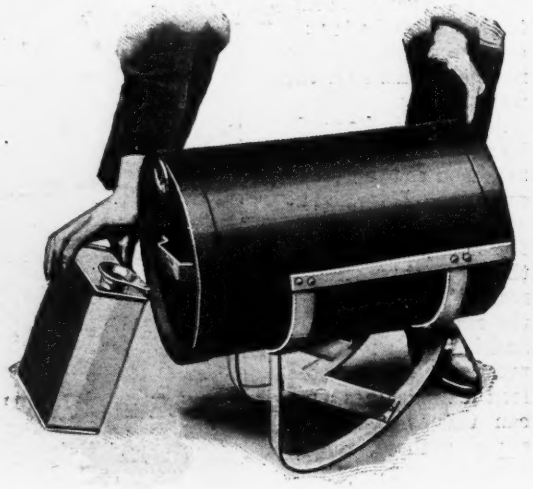
The Germans have recently brought out a machine that is attached to the front of a locomotive. It works on the same principle as the lawn-mower, cutting the weeds off very close to the ground.

We remove weeds from our railroads in this country by means of steam and fire. The foregoing seems a more practical method.

For Conveniently Tilting Heavy Cans

SURELY at various times you must have tried to empty the contents of one can into another, and failed. As you mopped up the spilled contents you wished that some one would invent a can-tilter. And now somebody has.

The tilter is simply made, as the picture below shows, and relies on rounded corners for its power. Place the can in the semicircular holder that naturally inclines at an angle, and tilt it from the rear. A slight touch of the finger will do the trick.

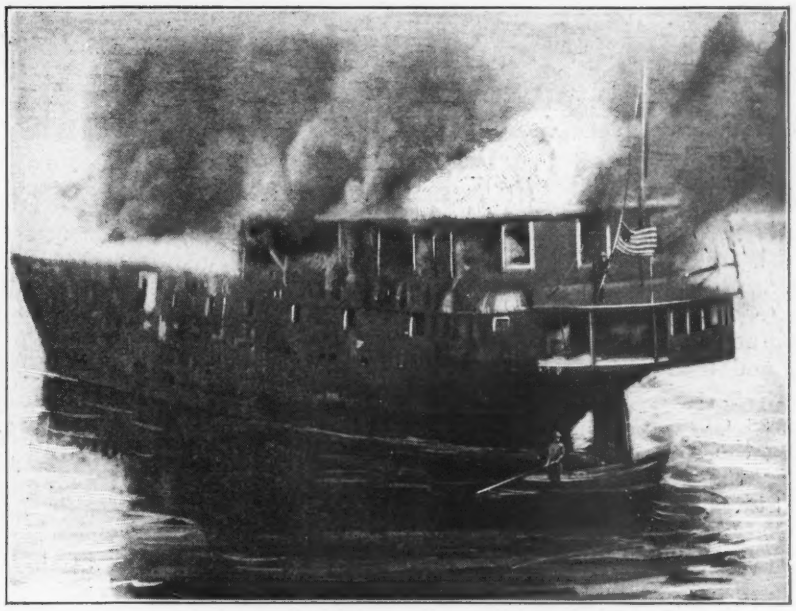


A Wrist-Pen for the Other Arm!

ABOUT the size of a wrist-watch, the ink-container having this new pen attached by a tube is strapped to the wrist. When not in use the pen is "capped." The flexible tube is wound around the reservoir and the pen is fitted into a small holder at the side of the ink-reservoir.

To write a letter, you merely lift out the pen, remove the cap, and begin writing. There is no hunting everywhere for a pen that is urgently wanted, but that is, for the moment, misplaced.

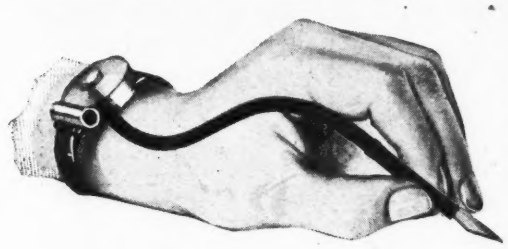
This is a handy and convenient article for the business man or woman.



Purify Dirty Pipes with Steam

DON'T scrape a pipe when you wish to clean it. Use the simple steaming device shown below. It consists of a metal water-container that can be attached to the hole in the mouthpiece of the pipe-stem by means of a short tube.

When the container, filled with water, has been screwed into place, you hold it over a flame. The water boils, steams, and the purifying steam will remove the nicotine. You hold the pipe so that the bowl is upside down while the steaming process goes on.



Making Liquefied Air

ORDINARY air turned to liquid is accomplished by pumping it through caustic potash to extract some moisture. Next it is compressed to 3000 pounds to the square inch, at which point it reaches a heat of 220° Fahrenheit. Then it is water-cooled to about 62° and forced through a tank of caustic potash and calcium chloride.

It is still in atmospheric form as it passes through iced copper coils. But when it reaches the liquefier, a coldness of 320° below zero turns it to liquid and it is then drawn off into airtight bottles for shipment to various places.

Why They Burned the *Richmond*

THE old wooden frigate *Richmond* had outlived her years of usefulness. So the navy decided to get rid of her. She was sold for junk and then towed to Eastport, Maine. She had been in service sixty-two years and had taken part in three wars.

The junking company decided to burn her and then gather up the scraps. Fires were prepared in various parts of the ship and set off at the same minute. The *Richmond* burned fiercely for several hours, and the American flag in the stern rippled in the breeze.

Just before the greedy flames reached it, Captain John F. Turner, the noted deep-sea diver, hauled it down and then jumped into the sea for safety.

The *Richmond* served under Admiral Farragut and was the pride of the navy at that time.

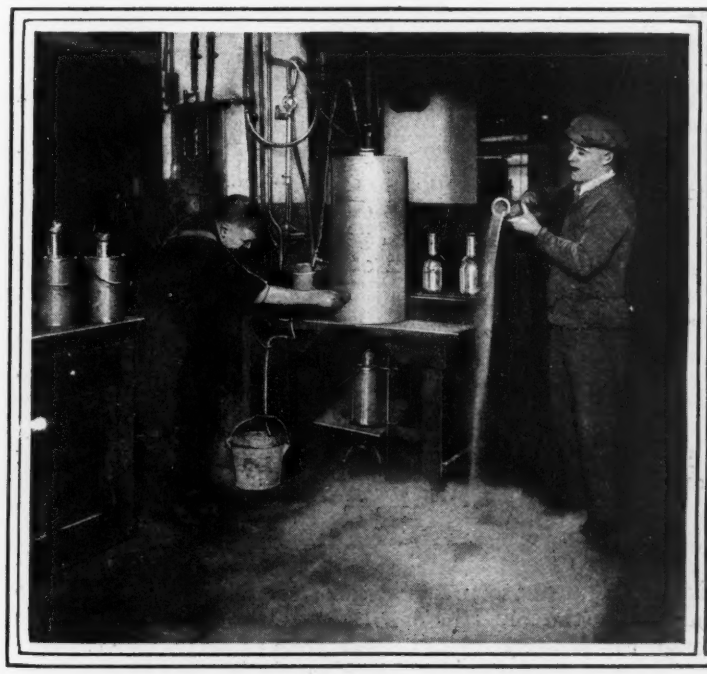
Now she is just a mass of twisted metal and burned oak timbers. Four other wooden war-ships—the *Minnesota, Wabash, Vermont,* and the *Franklin*—have been burned recently at the same place.

Laying Out the World

BELOW is shown the largest relief map of the world in the world in the process of construction. Not only is the map true to form, but every mountain range and every valley is given its proper size and height.

When the relief work is finished, air currents, water currents, and every steamship lane will be drawn in. This map was constructed especially for the marine show held in New York City a few months ago.

It is safe to say that this map will be in great demand as a reference by travelers of every description, but particularly by explorers, who make maps possible.



Salt Water, the Oil-Producers' Bugbear

When salt water spouts, your oil dividends stop

By Ernest Welleck

WHEN a new oil-field is opened and a "gusher" comes in that spouts thousands of barrels a day, the news is given considerable space in the papers. The reports of the opening of the new oil-fields in Oklahoma, Kansas, Texas, and California caused general rejoicing, and every patriotic American was elated when he learned that during the five years of the European war the oil production in the United States increased from 265,762,535 barrels in 1914 to 355,917,716 barrels in 1918, and to nearly 377,000,000 in 1919.

With increasing frequency in the past twelve months, the publications devoted to the interests of the petroleum industry published items worded like this: "The —— gusher, one of the greatest producers in the —— field, has developed salt water and has been shut in." Or: "The appearance of salt water in several wells of the —— oil-field has caused great consternation. It is feared that the entire district is doomed as an oil-producer."

Oil experts readily understood the meaning of these announcements, but to the average reader they were merely news items without particular significance.

A newly erected oil-"gusher." A successful gusher spouts thousands of barrels a day, sometimes over a period of many years

What has salt water to do with oil-wells, and why do they have to be closed when they "develop" salt water?

To answer this question it is necessary to explain the origin of oil deposits. It is now conceded by an overwhelming majority of geologists that petroleum was formed, under the influence of water, pressure, and time, by the disintegration or slow distillation of the deposits of algae and minute animal organisms, accumulated millions of years ago in the shore waters of the sea.

The Geological Formation

The remains of these plants and animals, together with mineral matter in a finely divided state, formed layers which, in the course of later geological periods, were buried under other layers. By the gradual uplift of the land mass the buried strata containing the remains of plant and animal life were raised above the level of the sea.

It is believed that under the great pressure of the superposed strata, the organic remains, in the presence of salt water and under exclusion of the air, were subjected to slow distillation or decomposition, possibly assisted by certain microorganisms. The products of disintegration—oil, and gas, together with the absorbed sea water—were forced out of the shale and into adjoining strata of more or less consolidated sand, soft sandstone, or similar porous material. There the water, oil, and gas separated according to their specific gravity.

The salt water, being the heaviest, collected at the lowest level, above it the oil, and above that the gas. If the strata had always remained in a horizontal position, the formation of pools or pockets of oil and gas in commercially valuable quantity would have been impossible. Only where the strata were folded by side pressure or locally raised in dome form by pressure from below, were the conditions favorable for the forming of oil or gas pools.

The cross-sectional part of the illustration that appears on page 59 shows a typical arrangement of the oil-bearing and gas-bearing strata in an oil-field.

When an oil-well is drilled until it reaches the oil-bearing sand, the oil will be forced up through the pipe by the pressure of the gas and the hydrostatic pressure of the water. It will form a gusher and will continue to flow with diminishing force until the supply of oil is exhausted or until it is drowned out by the encroaching salt water.

As the oil recedes under diminishing pressure, the level of the brine rises until it reaches the intake of the well. The invasion by the salt water is hastened by the pressure to which the brine is subjected by the gas accumulation in the adjoining fold.

The coming in of the brine invariably means the end of a well's productivity. Sometimes if the well is closed for a while, an increase in the gas pressure may cause the water to recede for a short time, thus prolonging the life of the well, but with a greatly diminished yield.

How Long Will the Oil Last?

Is the danger of complete exhaustion of our mineral-oil supply really so serious as represented? Optimists may refuse to believe in the prophecies of the scientists that the known underground supply of petroleum in the United States will be exhausted in less than twenty years.

Pessimists may eagerly point to the enormous and steadily growing demand for oil and the various products derived from it, the increasing difficulty of finding new sources of oil which would enable us to keep pace with consumption, and may argue that, long before the lapse of twenty years, we should depend for our oil supply on the wells in other parts of the world.

The United States Geological Survey estimates the quantity of our underground oil reserve at seventy barrels to each person, assuming a total population of 108,000,000 for the United States.

In 1919 the consumption of oil in the United States was about 3.6 barrels for each person. According to these figures, the reserve would become exhausted in less than twenty years, even if we assume that during that period there would be neither an increase in the population nor in the rate of consumption.

Reports from various large oil-fields in the United States and Mexico indicate that many of the older wells have either gone to salt water or have

developed a lack of pressure which makes it necessary to pump the oil. The production in the Pennsylvania oil-fields, which reached its climax in 1891, has steadily decreased since then. In the southwestern oil-fields, which are comparatively new, the decrease has also been marked. In the Kansas oil-fields the production in 1918 was more than 43,000,000 barrels. Since then it has dropped to about 30,000,000 barrels. The Oklahoma field, which produced nearly 118,000,000 barrels in 1915, produced only 84,000,000 barrels in 1919. In the north Texas field many of the wells have given out, but owing to the increased activity of the more promising fields, the production has materially increased in the past two years.

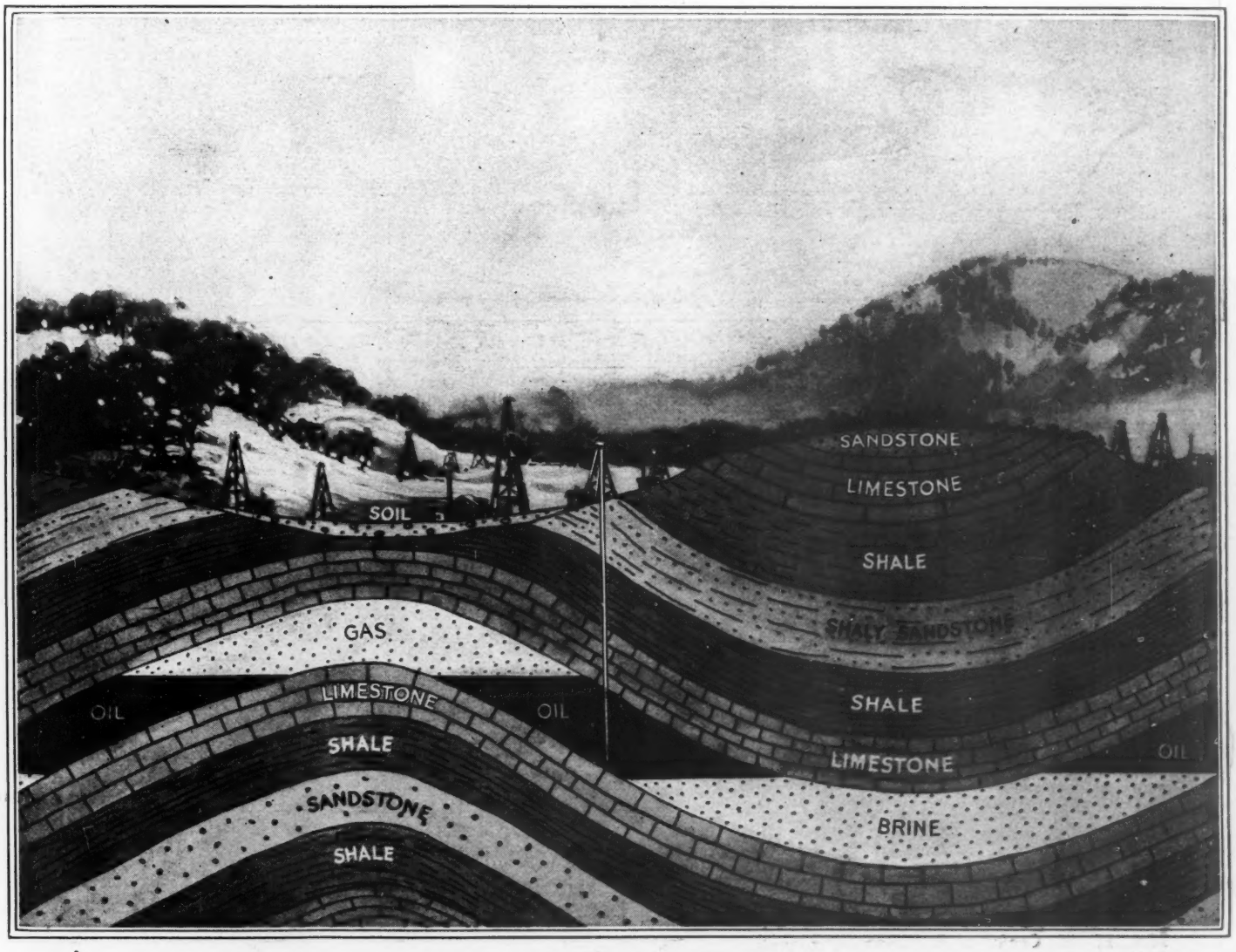
Ominous reports come from the rich oil-fields in the Tampico-Tuxpam section of Mexico. The famous Potrero del Llano No. 4, which was completed in December, 1910, and at first produced more than 100,000 barrels a day, developed a flow of salt water in December, 1918, and had to be closed. The pressure in several other large wells in the same section became reduced to such an extent that the original flow of from 10,000 to 50,000 barrels a day, dropped to 400 or 500 barrels a day. Potrero No. 4 was one of the largest oil-wells in the world and produced a total of more than 100,000,000 barrels before it was invaded by salt water. Its life as a gusher has been unusually long.

Havoc Wrought by Salt Water

In other Mexican fields similar invasions by salt water have been reported during the past year, and it is feared that the end of their productivity is near. Short periods of rest may restore the oil flow for a brief period, but the gushing days of these wells are over.

According to the figures computed by the United States Geological Survey, the United States uses twice as much petroleum as all the rest of the world, although its potential supplies are only one-seventh of the world's total. The other countries of the world consume about 200,000,000 barrels of oil a year. If there is no material increase in consumption, the supply of these countries will last probably twenty-five years. In the United States, however, more than 400,000,000 barrels of oil are consumed yearly, and the supply is estimated at this rate of consumption to last only from eighteen to twenty years.

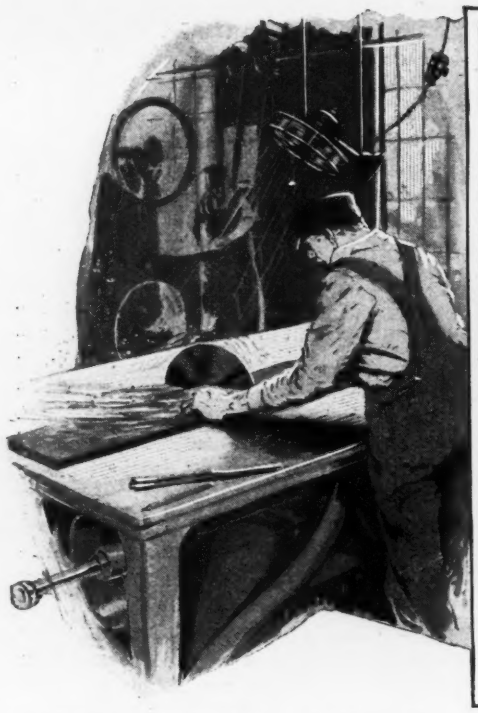
The commercial production of petroleum began in 1859 and during the years from 1859 to 1919 the United States produced nearly 5,000,000,000 barrels, or about 69 per cent of the total production of the world. During the year 1919 the American oil-wells produced about 356,000,000 barrels, while the consumption was 380,000,000 barrels. The difference of 24,000,000 barrels was taken from the above-ground reserve, estimated at a trifle more than 100,000,000 barrels. George Otis Smith, director of the United States Geological Survey, stated in an address before a recent meeting of the Institute of Mining and Metallurgical Engineers that to meet the demands of the shipping programme alone for fuel oil would require an increase in production of crude oil of nearly 200,000,000 barrels. He strongly advocated the reserve of domestic oil supplies for future American development, meanwhile exploiting foreign fields.



The oil is forced up by pressure. It is clear that the brine must rise as the oil is removed. Finally a point is reached when the brine reaches the pipe. Then salt water gushes instead of oil

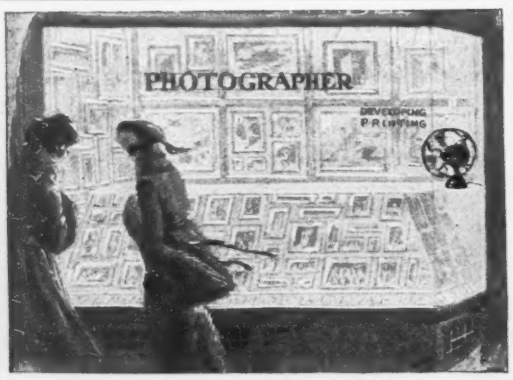
What Can You Do with an Electric Fan?

In answer to this question, readers of the Popular Science Monthly sent hundreds of suggestions. The prize-winning answers, and some others, are illustrated here



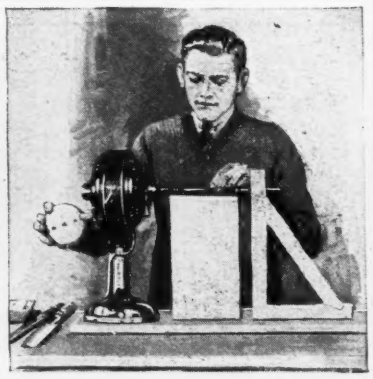
Clarence E. Paulson, of Kenmore, North Dakota, uses his fan to blow sawdust away from his work. The fan is mounted on an overhead bracket

First Prize. J. I. Hirsh, of Scotia, New York, won the first prize of $25. He made an iceless refrigerator with an electric fan and wet flannel sides for the icebox



Stanley J. Krygier, of Philadelphia, illustrates how a window can be kept free of frost. The electric fan blows warm air upon the glass

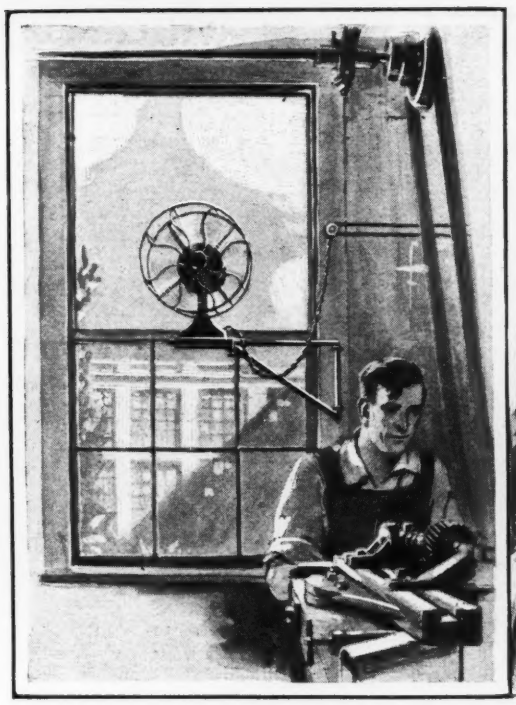
Dale Van Horn, of Lincoln, Nebraska, made a potato-slicer from an electric fan. Two butcher knives were attached in the place of the fan blades



U. J. Barbel, of Remsen, Iowa, converts his fan into a three-speed lathe, complete with all the fixtures, for fifty cents

Mrs. H. H. Craft, of Indianapolis, Indiana, lights the gas-range, sets the fan behind it, and the warm air quickly and effectively dries her hair

J. W. Moore, of Toronto, Canada, cuts down the high cost of ventilation by using one fan for two desks. The air striking the curved inside of the box spreads in two directions, thus keeping two persons cool instead of one



Second Prize. George G. Williams, of Nyack, New York, won the second prize of $15. His device exhausts all fumes and provides continuous fresh air

Arthur Goho, of Philadelphia, tickles the palate with appetizing smells from the restaurant kitchen. An electric fan wafts the aroma up through a pipe

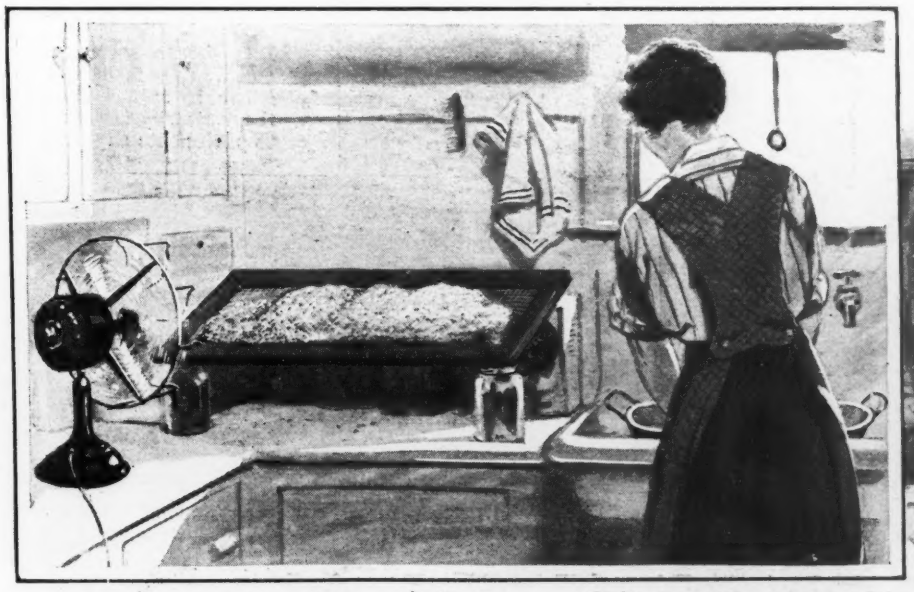
Fans Can Do More than Keep You Cool

We thank every one who took part in this contest, and announce that a new prize contest, "The Step-Saving House," begins in this issue. Read the rules set forth on page 102

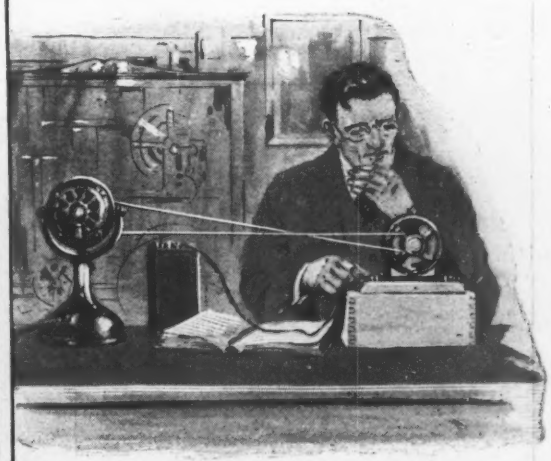
D. S. Keiser, of Philadelphia, had a shipload of meat. Trouble developed in the refrigerating motor. An electric fan kept the rheostat grids cool

Third Prize. H. M. Beach, of Fort Plain, New York, who won $10, prevents his photographic prints from clinging together by an oscillating fan

John Moos, of San Francisco, uses his fan to give the effect of a breeze while he is painting. Other artists would do well to copy this homemade breeze



Mrs. A. H. Bucklin, of Burley, Idaho, finds an electric fan indispensable in the kitchen to hasten the process of drying fruits and vegetables. The illustration shows the fan throwing a stream of air upon the drying-frame



U. J. Barbel runs a small direct-current generator by electric fan. The illustration shows the fan attached to the motor by a pulley and belt

Did You Ever Stop to Think How It Was Made?

Tennis-rackets are practically manufactured by hand and require a high grade of care and skill

Photographs © Keystone View Co.

Above the block and halfway up the sides of the racket a strip of wood is clamped in place. This serves as a reenforcement

The frame is given seven days in which to dry out. By the time the blocks and clamps are removed, the frame is rigid

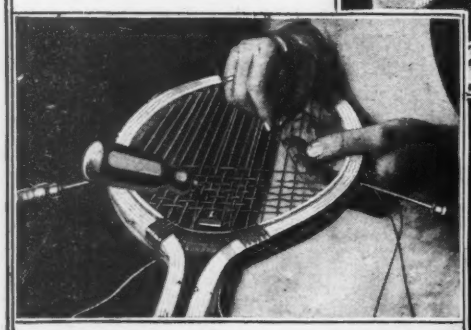
Above: The frame is made of a straight piece of wood, steamed until pliable. Then it is bent around a block and clamped together to make the handle

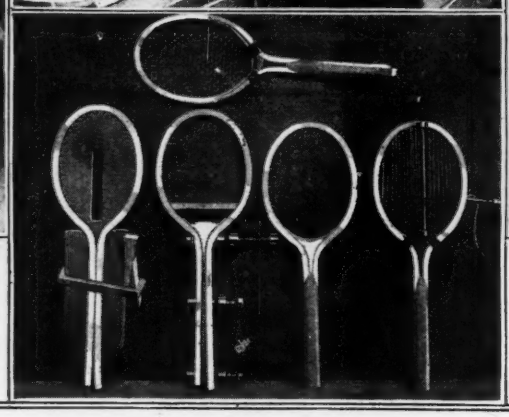
A block of wood is carefully made to fit beneath the shoulders of the racket. The fit must be perfect and great skill is needed to make it so

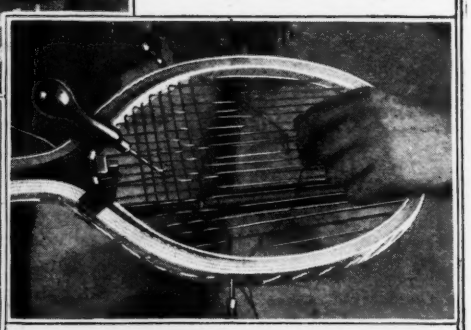
Handles must be smoothed off and holes for the gut must be hollowed out with precision

In order to keep the gut taut, each length is held by an awl until the next string is woven to prevent its slipping

Rackets are strung by hand. The lengthwise strings are adjusted first and then the crosswise ones are woven through







Five rackets in the various stages of construction. They show the amount of work needed to make a racket. Now, wielders of the catgut, be not so ready to growl at the price!

Keeping Up with the March of Science

Facts for the man who wants to know

Paper from Cotton Stalks

THERE is now a pulp-mill in Greenwood, Mississippi, that turns one hundred and fifty tons of cotton stalk into fifty tons of valuable paper pulp every day. A careful study of the cotton plant has led to the discovery that a certain thin tubular fiber in the plant will make excellent cellulose for durable papers. It is strong and flexible.

If a quarter of the annual supply of the cotton stalks of the South were put to this use each year, there would be no need of a paper shortage in this country.

Twine Grows on Trees

WE have always been told that everything in the world has its use, and we are seeing new evidence of it every day. The bark of eucalyptus trees, for instance, can be used for making twine, rope, and bagging.

The bark is first passed through a softening machine which loosens the fibers. Next it is put through carding and spinning machines. The resulting twine is strong, durable, and does not cost much to manufacture. The supply of bark is practically unlimited and can be easily gathered and sent to the factory.

Saving the Sardine

IF you are a lover of sardines, you will be glad to know that the prospects for a drop in price are good.

You see, porpoises like sardines just as much as you do, and their chances of getting them are better than yours. In fact, the fishermen on the coast of Brittany have appealed to the French Ministry of Marine about the great numbers of sardine-eating porpoises and have asked to have them bombed by seaplane.

If the ministry agrees, seaplanes carrying bombs will be stationed at all large fishing-ports. With your rivals blown up, the number of sardines will increase, and the price of them should subsequently drop.

Animals that Damage Crops

WHILE the cats are doing their best to kill off rats and mice, five hundred experienced hunters are campaigning against the larger predatory animals. It has been estimated that over half a billion dollars' worth of property in this country is destroyed each year by these animals.

The hunters poisoned the ground squirrels on fourteen million acres, last year. In one Idaho county forty thousand rabbits were killed. Practically all the prairie-dogs on two million acres were also destroyed.

The Cost of Fractured Legs

KATISHA'S well known elbow is certainly no more famous than Miss Florence D. Rooney's fractured leg. Miss Rooney was hurt in an automobile accident and as soon as she was able to walk again, she hobbled to court and sued the owner of the automobile for forty thousand dollars. She won her suit and now has the honor of possessing the most valuable leg in womandom. Moral: Don't run an automobile unless you have at least forty thousand dollars in the bank.

All Aboard the Air, Limited!

"FROM New York to Boston, Air Line Express, 230 miles in 200 minutes, fare $150," is the information given when the prospective passenger goes to secure passage for the trip. Passenger travel by air has arrived in earnest. One can make not only a swift trip, but a safe one.

The best train time for the trip would be about six hours; the saving in time is therefore nearly one half.

People spend time and money to reach the summit of a lofty mountain just to obtain the superb view it affords. At the ordinary altitude of its highway, the splendor of the sunlit landscape or the majesty of near-by cloudland, as seen from the moving air-line express, is the same as one would obtain from a mountain.

A company has already started service, not only from New York to Boston, but from New York to Atlantic City and other points within a radius of several hundred miles of the metropolis.

Now Comes the Square Tree

THE Cambridgeshire Forestry Association School of Forestry is "inclined to stake its reputation that this can be done," the "this" meaning the growing of square trees. The idea seems to have been originated by Mr. Alfred J. Winslip, who has studied the method practised by gardeners in slitting the bark of fruit-trees to make wood. When the bark is bruised without being removed or even slit, a growth of a somewhat different kind takes place. But whatever the method used may be, the wood is of greatly superior quality to that of the parent tree. According to the Cambridgeshire association, there will be "no more slabs, no wavy planks, no more horrid sums to convert frustra of cones into cubic feet," when trees are grown square. "If we can control this excessive wood production," the report of the Cambridgeshire association concludes, "there is no reason why we cannot make trees grow square to produce wood of better quality and in greater quantity."

Why Some Sand Sings

NEARLY the whole eastern side of Lake Michigan from Gary to Mackinac is fringed by singing sands. Walk on the sand or thrust a stick into it when it is dry, and it "sings."

Dozens of explanations have been advanced to explain why the sands sing. The most plausible is that recently advanced by Mr. W. D. Richardson. He noted in the first place that the sands did not sing beyond the line reached by driftwood.

There must be some relation between the periodical wetting of the sands and the sounds that they emit. Mr. Richardson came to the conclusion that the lake water deposits a thin film salt upon the grains of sand. When the grains are rubbed together the film creates considerable friction. The effect is similar to that of rosin on a violin bow.

Back of the driftwood line the wind rubs off the film as dunes are formed, and the rain completes the removal. That is why the inland sands are not "musical."

Uses for Waste Iron

WE were told to be thrifty during the war, but only those companies that could not obtain raw material paid much attention to the suggestion.

What thrift means is driven home by the way in which the railways are reclaiming and utilizing scrap metal. A large reclamation plant, established by Rock Island lines at Silvis, Illinois, ought to be studied by the owners of large metal-working plants. Bolts and nut locks reclaimed during one month amounted to $599 at a total cost of $89. In the same time 27,065 pounds of nuts were reclaimed by sorting and re-tapping at a net saving of $72. About 17,043 pounds of lag screws were reclaimed by re-threading until

they were as good as new; the saving amounted to $133.

Cast-iron spokes are welded on driving wheels; worn spots on firebox castings are built up by means of the acetylene torch; flange-worn steel-tired wheels are mated and paired before turning; oil is pressed from waste, one barrel of waste netting about twenty gallons of oil; waste is also burned and babbitt metal reclaimed.

Corncob Efficiency

THE lowly corn-cob, industrially used only in the making of pipes for smokers, is about to be promoted to new industrial uses as the result of some remarkable experiments made by the Bureau of Chemistry of the United States Department of Agriculture.

Out of corn-cobs furfural is obtained, a comparatively rare product which is sold in very small quantities for scientific purposes, at about seventeen dollars a pound. The process developed by the Bureau of Chemistry yields furfural from corncobs at perhaps fifteen or twenty cents a pound. Out of it can be made a great many kinds of dyes, several paints and lacquers, hard rosins similar to those used in making pipe-stems and like articles, and a useful insecticide.

A plant handling about one hundred tons of cobs a day can recover about a ton and a half of furfural a day as a by-product. Moreover, two grades of adhesive are recovered from the cobs, one of which is a substitute for silicate of soda in the manufacture of fiber containers and wall-boards, and the other of which can be used as a binder for briquetting coal-dust. The United States produces about twenty million tons of cobs a year. Who knows but some day it may pay to grow corn just for the cobs?

Buying Rosin by Color

ROSIN is rated primarily according to its color. But what are the standards of color? To assist rosin buyers the Bureau of Chemistry of the United States Department of Agriculture has designed sets of standard glass for all types of rosin. Small blocks of rosin are compared with the glass type blocks in the end of what is called a comparison box—a structure about twenty-four inches long, open at both ends, and equipped to hold two cubes at one end. You simply look through this box toward the light. When a sample has the exact color of the type block, or is darker than the next higher type block, the grade is that of the lower or darker type block. The Bureau of Chemistry lends these glass type blocks to disputants in a controversy.

Electrifying Seeds for Growth

DOES electricity make seeds sprout faster? It is commonly supposed that electrification has a miraculous effect on germination. A well known British firm of seedsmen determined to carry out some experiments with seeds electrified by the Wolfryn process in order to discover for itself whether or not there is any efficacy in electrification.

The Wolfryn treatment consists in immersing the seeds in a solution of common salt and water or calcium chloride and water to which an electrical current is then applied. The seeds, after having been dried at a temperature of one hundred degrees Fahrenheit, are ready for sowing.

Seeds treated by this process; seeds unelectrified but soaked for four hours in a solution of salted water and afterward dried at a temperature of one hundred degrees Fahrenheit; seeds unelectrified but soaked for four hours in a solution of sulphate of ammonia and water and subsequently dried at a temperature of one hundred degrees Fahrenheit; and finally seeds untreated in any way, were tested on a farm, side by side.

And no positive evidence was obtained that electrified seed is any better than ordinary seed.

Catching Fleas with Salt

HOW to catch the elusive flea and destroy him is a problem that has been solved by the Bureau of Entomology of the United States Department of Agriculture. The remedy is salt.

Clean the basement, shed, or other breeding-place, burn the rubbish, and then sprinkle the floor or ground with common salt (enough to cover the ground), and then wet the salt with water.

It is sometimes necessary to repeat the operation two or three times at about three-day intervals.

Heating Water with Starlight

PROFESSOR J. B. Stebbins, the distinguished American astronomer, was the first to make accurate measurements with modern instruments of the heat received by the earth from stars, so distant that we see them not with the light that they radiate to-day, but with that which left them centuries ago. His methods have been improved upon by Dr. W. W. Coblentz, another American.

Dr. Coblentz' instruments are extraordinarily sensitive. They measure the heat of a candle in the focus of the great Mt. Wilson reflector at a distance of one hundred kilometers (sixty-two and one tenth miles). In his experiments Dr. Coblentz found that the Pole Star radiates just about enough heat to raise the temperature of a gram of water one degree Centigrade in a million years. Dr. Coblentz concludes that the total radiation that falls upon the earth from all the stars might perform the same work in one hundred to two hundred years.

Salmon Need Protection

COMMERCIAL salmon-fishing in the rivers of British Columbia, is carried on entirely with drift-nets. Hair seals attack the enmeshed salmon and either devour them or mutilate them to such an extent that they are of no commercial value. The Canadian government is now looking for some invention which will meet the situation.

It has tried to kill the seals by dynamite as they gather on a long sand spit at low water, also to impale them with large hooks attached to what are known as "sturgeon crosslines"—all without avail.

Hair seals abound practically on all portions of the Canadian coast. They are a nuisance not only on the American continent, but in Europe as well. No satisfactory method of combating them has been found. They are not in very large numbers in one place and they cannot be hunted successfully.

Who is the inventor that will solve the problem?

Scrap Iron in Cakes

IN every machine-shop and foundry waste metal accumulates in the form of chips, shavings, and fragments of various sizes. In some plants, waste is sold to the scrap dealer and in the others it is melted up again for further use.

This melting, however, is attended with some difficulties. Unless the metal waste is compressed by powerful machines into briquets, the losses in the furnace are too great. On the other hand, briquetting is too expensive.

Now comes a Frenchman with a process for doing away with briquetting entirely—that is with the expensive briquetting machinery. He mixes the shavings with cement and with a diluted solution of ammonium chloride just as he would mortar or concrete. Then he tamps the mixture into a wooden mold and lets it dry.

Thus he obtains cakes that will stand considerable rough handling on the way to the furnace. The cement, of course, runs off in the form of slag during the process of smelting.

Let's Gather Some Weeds for Dinner

Cows eat grass—why shouldn't we? Two New York chefs, on economy bent, went out into the fields and picked some sorrel. They tasted it, and decided to use it for soup. Mixed with milk and potatoes, it gives soup an excellent flavor. Europeans have been eating sorrel for centuries; Americans have something to learn from them

Mushrooms—they grow wild, and if you look for them you'll surely find them. But be careful not to pick poisonous ones by mistake. Don't take any chances; find out exactly how to recognize edible mushrooms before you eat them. Heed this warning!

Why pay fabulous prices for asparagus when pokeweed tastes as good? One chef boiled some and found it soft, tender, delicious. The young weeds are the best

Cooked dandelions make you healthy—and so do fresh ones, says the chef. He has just gathered some. Cooked dandelions taste like spinach, but are cheaper

The two chefs have stopped to look over their haul. Soups, salads, and vegetable dishes can be prepared from the weeds they gathered

they were as good as new; the saving amounted to $133.

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Salmon Need Protection

COMMERCIAL salmon-fishing in the rivers of British Columbia, is carried on entirely with drift-nets. Hair seals attack the enmeshed salmon and either devour them or mutilate them to such an extent that they are of no commercial value. The Canadian government is now looking for some invention which will meet the situation.

It has tried to kill the seals by dynamite as they gather on a long sand spit at low water, also to impale them with large hooks attached to what are known as "sturgeon crosslines"—all without avail.

Hair seals abound practically on all portions of the Canadian coast. They are a nuisance not only on the American continent, but in Europe as well. No satisfactory method of combating them has been found. They are not in very large numbers in one place and they cannot be hunted successfully.

Who is the inventor that will solve the problem?

Scrap Iron in Cakes

IN every machine-shop and foundry waste metal accumulates in the form of chips, shavings, and fragments of various sizes. In some plants, waste is sold to the scrap dealer and in the others it is melted up again for further use.

This melting, however, is attended with some difficulties. Unless the metal waste is compressed by powerful machines into briquets, the losses in the furnace are too great. On the other hand, briquetting is too expensive.

Now comes a Frenchman with a process for doing away with briquetting entirely—that is with the expensive briquetting machinery. He mixes the shavings with cement and with a diluted solution of ammonium chloride just as he would mortar or concrete. Then he tamps the mixture into a wooden mold and lets it dry.

Thus he obtains cakes that will stand considerable rough handling on the way to the furnace. The cement, of course, runs off in the form of slag during the process of smelting.

When a Larva Does Not

Let's Gather Some Weeds for Dinner

Cows eat grass—why shouldn't we? Two New York chefs, on economy bent, went out into the fields and picked some sorrel. They tasted it, and decided to use it for soup. Mixed with milk and potatoes, it gives soup an excellent flavor. Europeans have been eating sorrel for centuries; Americans have something to learn from them

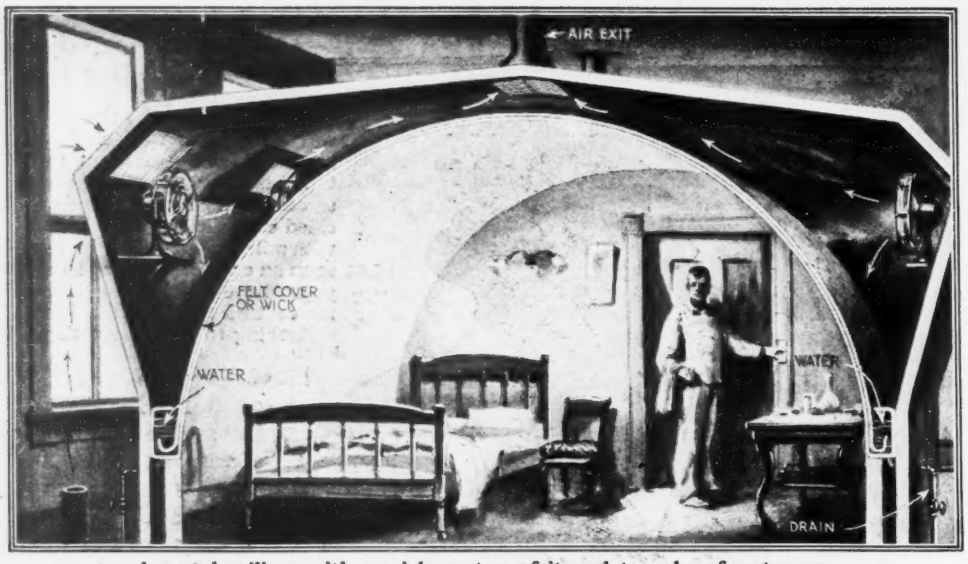
Why pay fabulous prices for asparagus when pokeweed tastes as good? One chef boiled some and found it soft, tender, delicious. The young weeds are the best

Mushrooms—they grow wild, and if you look for them you'll surely find them. But be careful not to pick poisonous ones by mistake. Don't take any chances; find out exactly how to recognize edible mushrooms before you eat them. Heed this warning!

Cooked dandelions make you healthy—and so do fresh ones, says the chef. He has just gathered some. Cooked dandelions taste like spinach, but are cheaper

The two chefs have stopped to look over their haul. Soups, salads, and vegetable dishes can be prepared from the weeds they gathered

A Motor-Truck that Scoops



A metal ceiling, with a wick on top of it and troughs of water running around the edge, will keep you cool in the hottest weather

'Twas a Hot Night in Summer

AN air-cooler has been invented by Mr. Robert Richardson, of Los Angeles. According to the patent papers it is used on a "sleeping enclosure or space wh ch is constructed, formed, and adapted to receive a bed"—in simple language, a bedroom.

The ceiling of the bedroom is made of metal and drops at the edges. On top of the ceiling there is a large wick that terminates in troughs running around the ceiling's edge. These troughs are kept full of water. The wick absorbs the water, and evaporation cools the metal ceiling.

Should you find yourself without a bedroom on a hot summer night, you might sleep in comfort on the fire-escape or roof by using another form of this versatile patent.

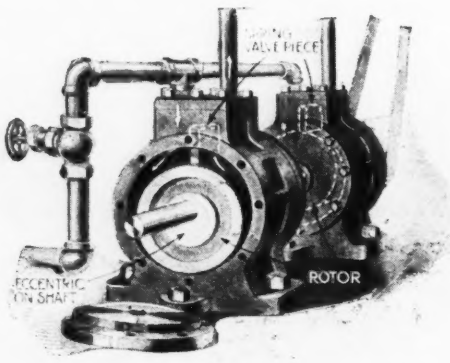
It is a small sleeping compartment—just about as long and wide as you are—having a spring, a mattress, and a canopied top, open at both ends. The same water-troughs and wick keep you cool.

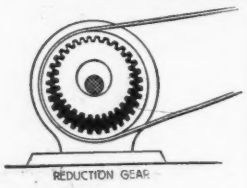
Pressing Out Liquids with a Pump

HERE'S a new type of rotary pump that expels liquids by a curious "squeegeeing" device. A disk loosely mounted eccentrically on a shaft rolls around the inside of the pump-casing, the eccentric acting as a bearing. One of the openings, the suction valve, permits the liquid to flow in, and the other opening permits the liquid to be expelled by the rotating disk. For a pump whose speed is one thousand revolutions a minute, there are sixty complete turns a minute past the valves, the disk rotating around its own center at a speed proportional to the difference in diameter between the casing and the diameter of the disk, or rotor.

The squeegee action of the rotating disk drives the liquid around in front of the rotor, and, as the suction valve is closed at the time, the liquid is forced around and expelled through the delivery port. A sliding metal bar, always in contact with the rim of the rotating disk, separates the two valves.

The pump is designed to work "tandem" with another set of valves and another rotating disk whose eccentricity is contrary to that of the first rotor. This produces a noiseless mechanism and provides a steady flow of the expelled liquid.





The eccentrically rotating disk controls the valves of this rotating "squeegee" pump, admitting and expelling the liquid

The principle involved in this "squeegee" pump has been developed into a reduction gear for mechanical purposes.

The casing within which the rotor whirls contains a ring having teeth to engage a loosely, eccentrically mounted pinion which rolls around inside it. The reduction of speed is proportional to the diameters of the pinion and the ring. The invention is remarkably simple and efficient.

The modern mechanical engineer is ever striving to produce results from the simplest forms of mechanism, and in this curious pump he seems to have succeeded. The rapidly whirling disk tends to hurl the liquid which enters through the first valve around to the point where it is literally "squeezed" out of the second valve. There is little friction to work against the forward movement.

When a Larva Does Not Become a Moth

CODLING moths are the bolsheviki of the orchard; they annually destroy millions of dollars' worth of fruit and trees. Recently, however, one of the expert entomologists of the United States Department of Agriculture invented a trap.

The trap coaxes the bugs in and then will not let them escape. It lures the minute larvae within its portals, where they spin cocoons and finally change into moths. In the moth form they are too large to pass out through the holes by which they entered.

Strips of burlap six inches wide are folded into three thicknesses. The loose bark from the trunk and lower branches of the tree is removed and a strip of this burlap is folded once around the trunk. It is held in place by large tacks, which are so driven that the edge projects about one fourth of an inch beyond the burlap. The burlap is then covered with black wire screen, twelve meshes to the inch. The screening is cut into strips six inches wide and the edges of each strip are folded twice, allowing one fourth of an inch to each fold.

The strip of screen must be long enough for an overlap of four inches when placed around the tree trunk. The screen is tacked in place over the burlap so that the upper and lower edges fit snugly against the bark. The projecting tacks used to fasten the burlap prevent the wire from touching the cloth. To make the trap doubly tight, a thin coating of hot pitch tar is applied along its edges. After the larvae have filled up on fruit, they seek shelter wherein to spin their cocoons. They crawl down the trunk until they reach the trap. As larvae they easily enter through the meshes in the screening and spin their cocoons under the burlap band. The emerged moths are unable to escape owing to their increased size, and soon die or are destroyed by other insects.

Burlap and wire screening prevent the insects from climbing up the tree

A Motor-Truck that Scoops Up Earth

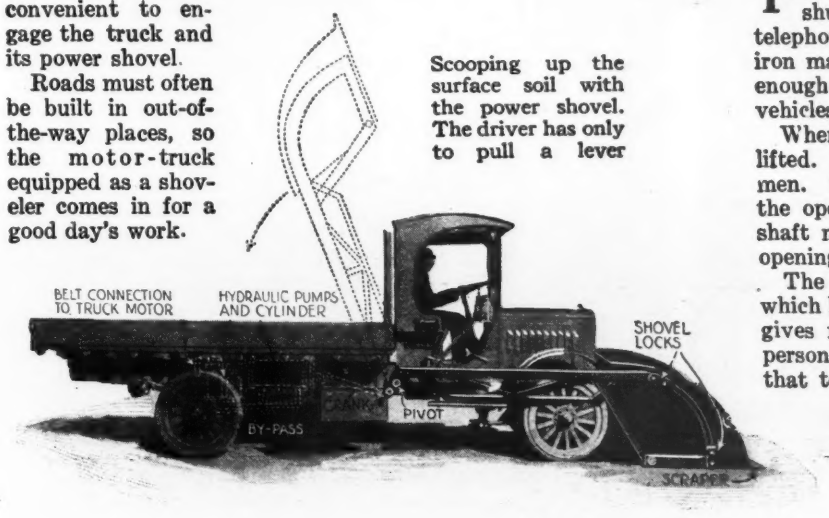
A MOTOR-TRUCK equipped with a shovel is a convenient combination when roads must be built, or when the top soil is to be raised. Here is a large tract of land that must be graded. The usual method is to use a road-scraper to remove the soil, which is then loaded in wagons.

The power-shovel, patented by Mr. E. L. Beaty, does similar work in a different manner.

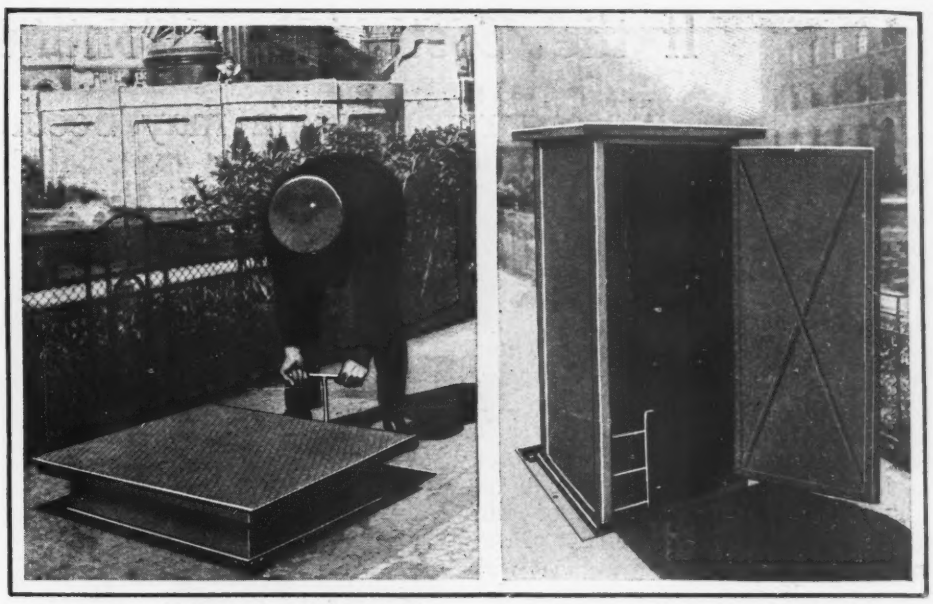
The truck shoves along with its great open shovel and scoops up the top soil. The driver of the truck then touches the lever, which shifts the driving mechanism of the truck to operate hydraulic pumps, which in turn drive a large hydraulic piston, raising the loaded shovel so that its contents are discharged into the body of the truck. A by-pass arrangement enables the driver to reverse his power and, assisted by gravity, bring back the empty shovel to its normal position, ready to repeat the performance of removing the soil.

It is not always convenient to secure the services of a steam-shovel and the necessary crew to operate it. In some instances it would be far more convenient to engage the truck and its power shovel.

Roads must often be built in out-of-the-way places, so the motor-truck equipped as a shoveler comes in for a good day's work.



Scooping up the surface soil with the power shovel. The driver has only to pull a lever



Turning the key releases a catch and the boxlike cover-house emerges

The manhole-house with its door open and its iron ladder in position

A Little House Protects the Manhole

THE openings of the shafts that give access to sewers, to the shut-off valves of water-mains, or to the conduits in which telephone or telegraph wires are housed, are protected by heavy iron manhole-covers laid flush with the road level, and strong enough to bear the weight of the heaviest trucks and other vehicles.

When there is work to be done in the shaft, the cover must be lifted. This usually requires the combined efforts of several men. To prevent accidents, guard-rails must be placed around the opening, and in rainy weather the men working in the shaft must be protected by a small tent erected above the opening.

The manhole-cover shown in the accompanying pictures, and which has been introduced in several cities in Germany, not only gives more adequate protection, but can be operated by one person. The manhole-cover forms the roof of a rectangular box that telescopes into the opening of the shaft. It is counter-balanced and can easily be raised or pushed down by one man after the catch that holds it in position has been released by turning a key. A hinged door provides access to the shaft-box, which is also equipped with an iron ladder.

Purifying Metal by Means of Air

GLASS-BLOWING is an ancient art, but the application of air-pressure to molten metal is quite a recent feat of the experimental foundry. In this case the compressed air is not used to produce fantastic or artistic shapes, but rather to force the pure fluid mass of metal smoothly into a special mold prepared to receive it.

Alloys of copper intended for exceedingly particular and exacting use must be cast free from dross and other impurities.

It is necessary to obtain for the molds the liquid metal occupying the bottom of the crucible. How to get it without getting the dross on top has been a problem.

Now there is a clever arrangement by which compressed air can be used to force the pure metal in the bottom of the crucible up through a pipe into the mold.

The crucible is put into an airtight compartment, through the top of which can be inserted the tube leading to the mold in which the ingot of copper-alloy is to be cast. Compressed air enters the side of the compartment containing the open crucible, a pressure gage indicating the pressure.

Compressed air presses down upon the surface of the metal, forcing the purest portion into the mold

The air presses upon the surface of the metal in the crucible, forcing it down and thus forcing upward through the tube into the mold the p rest metal in the bottom of the crucible.

The usual method of pouring the molten metal from the crucible into the mold makes it practically impossible to avoid a small amount of the objectionable impurities getting through. But when the pressure is brought upon the upper surface of the metal, through which a hollow tube has been extended, the pure metal at the base of the crucible is forced upward through the tube.

What shape the metal is to be molded is decided by the hollow mold connected with this tube. As the compressed air operates with gentle but persistent force, the liquid at the bottom finally reaches the mold.

If the Cost of Ice Continues to Rise

Electric refrigeration may become profitable

By John Stuart

ELECTRIC refrigeration has been a dream of inventors for years. Can we use electricity for refrigeration? Will it ever be done? These are the questions that interest us, while our mind's eye sees visions of a truly electric age when icemen and their carts, and the overflowing drip-pans of household iceboxes, will be no more.

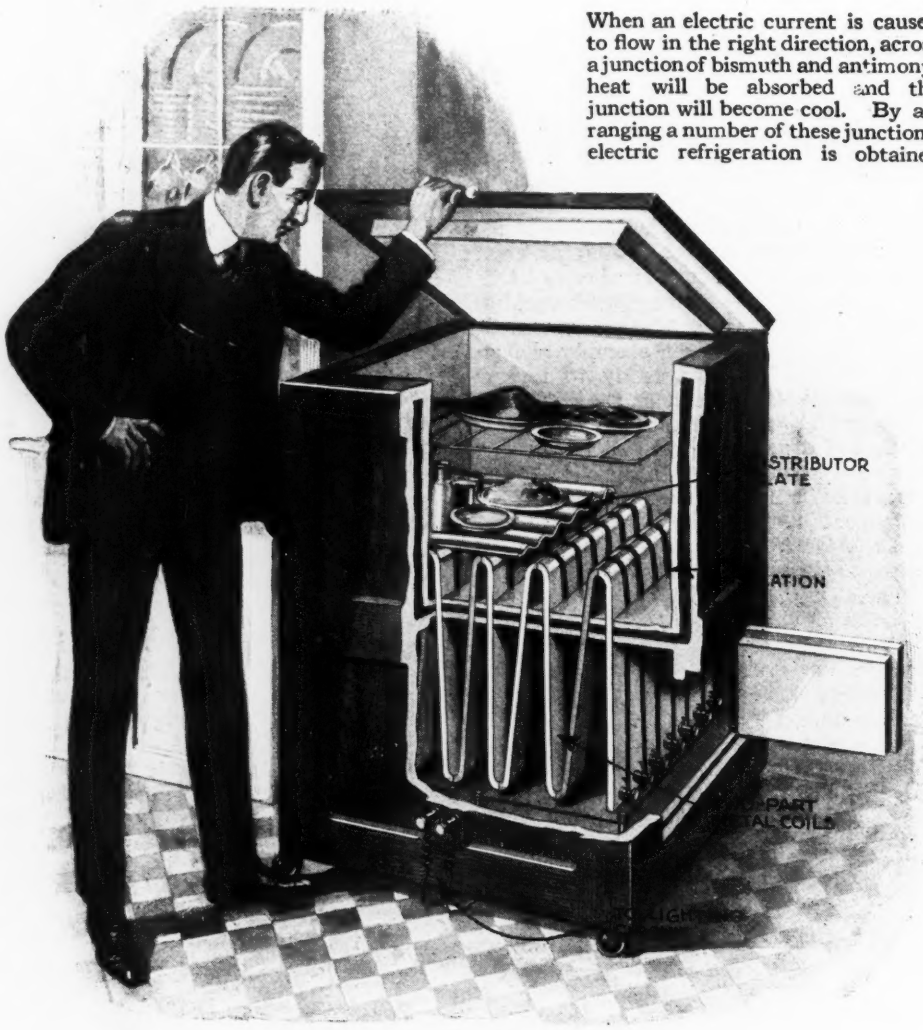
The electric refrigerator of the future will look much like that of the present, but its ice compartment will be used for food. Within its walls there will be embedded an ingenious network of wires carrying the electric current which will continuously abstract the heat.

It can be done, and we shall see why, later; but will it ever be done? Put the question differently. As early as 1889 a patent was issued to Mark W. Dewey which is based on some of the most interesting but less widely known laws of electricity. Why has no one ever built and sold electric refrigerators? Because they would be expensive, perhaps ten or twenty times as expensive as an ordinary ice-cooled box, and because it would cost a good deal for the electric current that would be required to operate them.

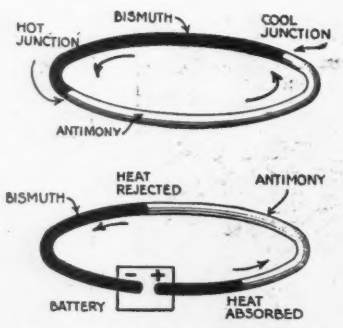
The Unequal Competition with Ice

As long as ice was cheap, say thirty or forty cents a hundred pounds, no manufacturer could hope to make money by offering for sale a refrigerator that would cost perhaps a thousand dollars instead of a hundred, and would burn up fifty or sixty cents' worth of electricity to get the same cooling effect as a hundred pounds of ice would produce. But let ice sell for eighty cents or a dollar a hundred, and the possibility of business may attract some manufacturer.

Electric refrigeration can never compete in the quantity production of ice with a real northern winter, or with the more reliable method of the large ice-plants that use ammonia or sulphur dioxide or other poisonous gases. It is only for household use that electric refrigeration can ever be economically possible.



When an electric current is caused to flow in the right direction, across a junction of bismuth and antimony, heat will be absorbed and the junction will become cool. By arranging a number of these junctions, electric refrigeration is obtained



(*Above*) An electrical pump formed by different metals, one junction being heated

(*Below*) When current flows from the battery the electric pumps oppose it. At one pump heat is taken in and at the other it is rejected

Inventions of electric refrigerators have all depended upon a knowledge of the laws of heat and of electricity. Heat itself is merely energy—what the scientist defines as "the ability to do work." When we take heat energy away from one place we must put it somewhere else. That is what the large ammonia ice-plants do; they take heat from the water that is to be frozen, and give it up to the air around the plant. First the ammonia gas is compressed, and this makes it hotter, just as the air in a bicycle-pump gets hotter when it is compressed. The compressor and the gas are cooled by running water in a jacket around the compressor. This cooling water takes up the heat, and later is allowed to give it to the air by partial evaporation. In the meantime the compressed ammonia is piped to a chamber where it can expand rapidly, and, in consequence cools. The cooled gas takes heat from its surroundings, and is then returned to the compressor.

Ammonia or Electricity

The method of electrical refrigeration is so similar to this familiar mechanical process that it may be described in almost the same terms. Let us therefore redescribe the ammonia process in such a way as to bring out what is essential to understanding the electrical process. A fluid is piped around a conductor. At one point there is a compressor, which means that the gas passes from a point of low pressure on one side of the pump to a point of high pressure on the other side. When it does so, it gives

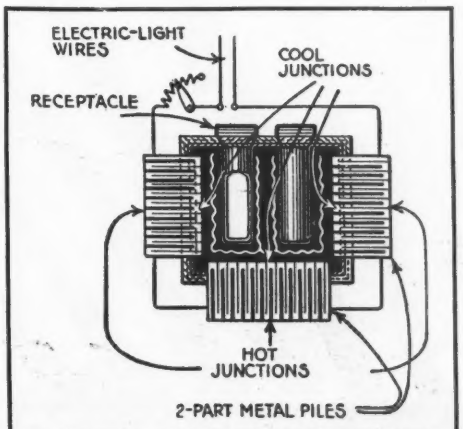
up heat to its surroundings—this is the heat that must be removed by the cooling water. Later, in its path along the conducting pipes it is allowed to expand, passing from a point of high pressure to one of lower pressure. It is at this point that the fluid takes up heat from its surroundings—that is, cools whatever is to be refrigerated.

Electricity behaves like a fluid, although as a matter of fact it is really very minute particles, the electrons that modern science has discovered. It may be pumped around a conducting wire by a battery or dynamo, just as fluids are pumped through pipes. A battery or dynamo is merely an electrical pump on one side of which the electrical pressure is lower than on the other side.

The First Electric Pump

The first electric pump was made by Volta in 1800. He put together two different kinds of metal, connecting them with a bit of cloth damp with acid, and so made the first electric battery. Twenty-one years later another kind of electric pump was discovered. A man of the name of Seebeck fastened two dissimilar metals into a ring and heated one of the junctions. He found that a current of electricity was caused to flow around the conducting path formed by the two metals. The junction of two dissimilar metals acts as an electric pump when it absorbs heat from its surroundings. It remained for Peltier in 1834 to discover the reverse of this phenomenon. If a current of electricity is passed through the junction of two unlike metals in the form of a cross, the junction will be heated or cooled, depending upon the direction of the electric current when it is turned on.

Connect a strip of nickel to one of iron so as to form a ring. Heat one junction, and a current will flow around the circuit. At the heated junction it will flow from nickel to iron. This junction acts like an electric pump. At the cooler junction the current flows in the opposite way.



In the walls of this refrigerator are hundreds of alternate strips of bismuth and antimony. When the current flows, the outside junctions of these strips reject heat which the inside ones have absorbed

Now put a battery into the circuit. At one junction the battery current will flow from nickel to iron, that is, in the same direction as it would if we heated this junction. This junction must absorb heat, for if it rises in temperature it will act like a pump, keeping the current going in the same direction as we started it. We should then have perpetual motion.

At the other junction, where the battery current is in the opposite direction, heat is given off; that is, the junction rises in temperature. It then acts like a pump opposing the battery current. In any electrical circuit, as the student of direct-current motors knows, passing current through an electrical pump makes the pump act to oppose the flow of current, not to assist it.

There is a neat experiment that may be performed to show this phenomenon of the absorption of heat at one junction and its rejection at another. Make a circuit of bismuth and antimony. Place a little ice around one junction and a little ice-cold water around the other. Pass a current through the circuit in the proper direction, and the ice will melt while the water freezes.

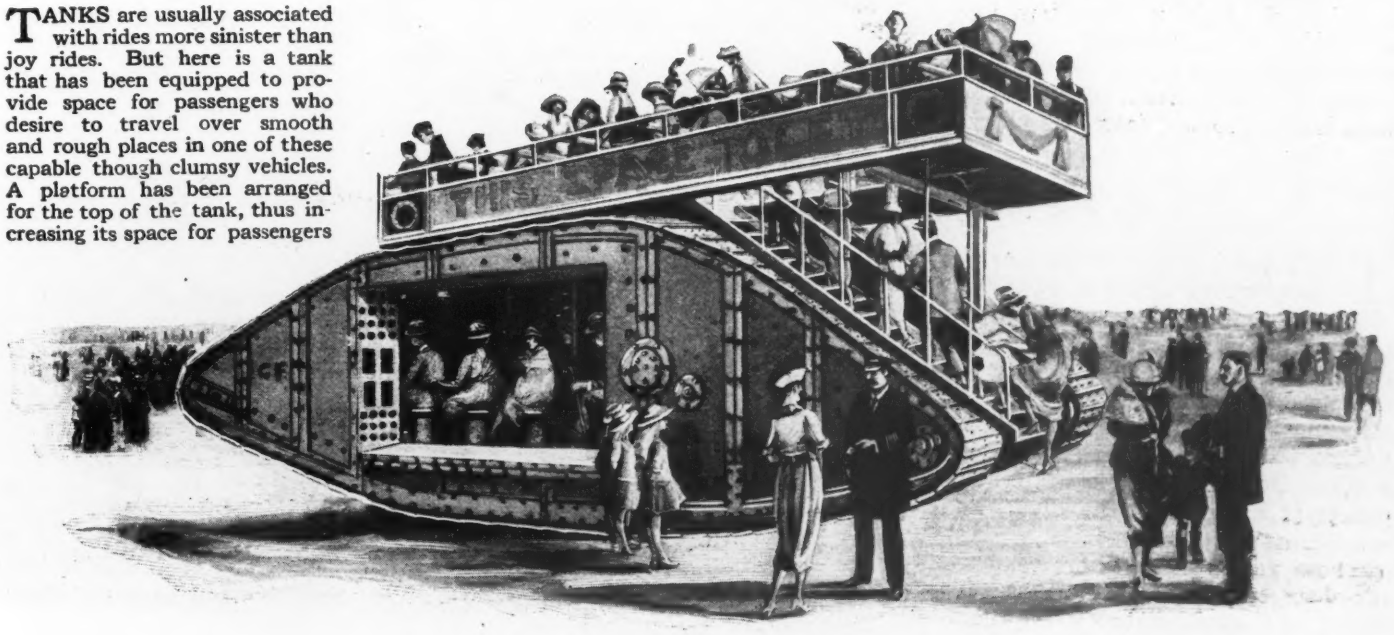
The effect, however, is very small. These thermo-electric pumps develop only a fraction of a volt for each degree of temperature to which they are heated. It is exactly as if we tried to run an ammonia machine with a poor compressor, and with so small an enlargement of the pipe where expansion occurred that the gas cools but slightly.

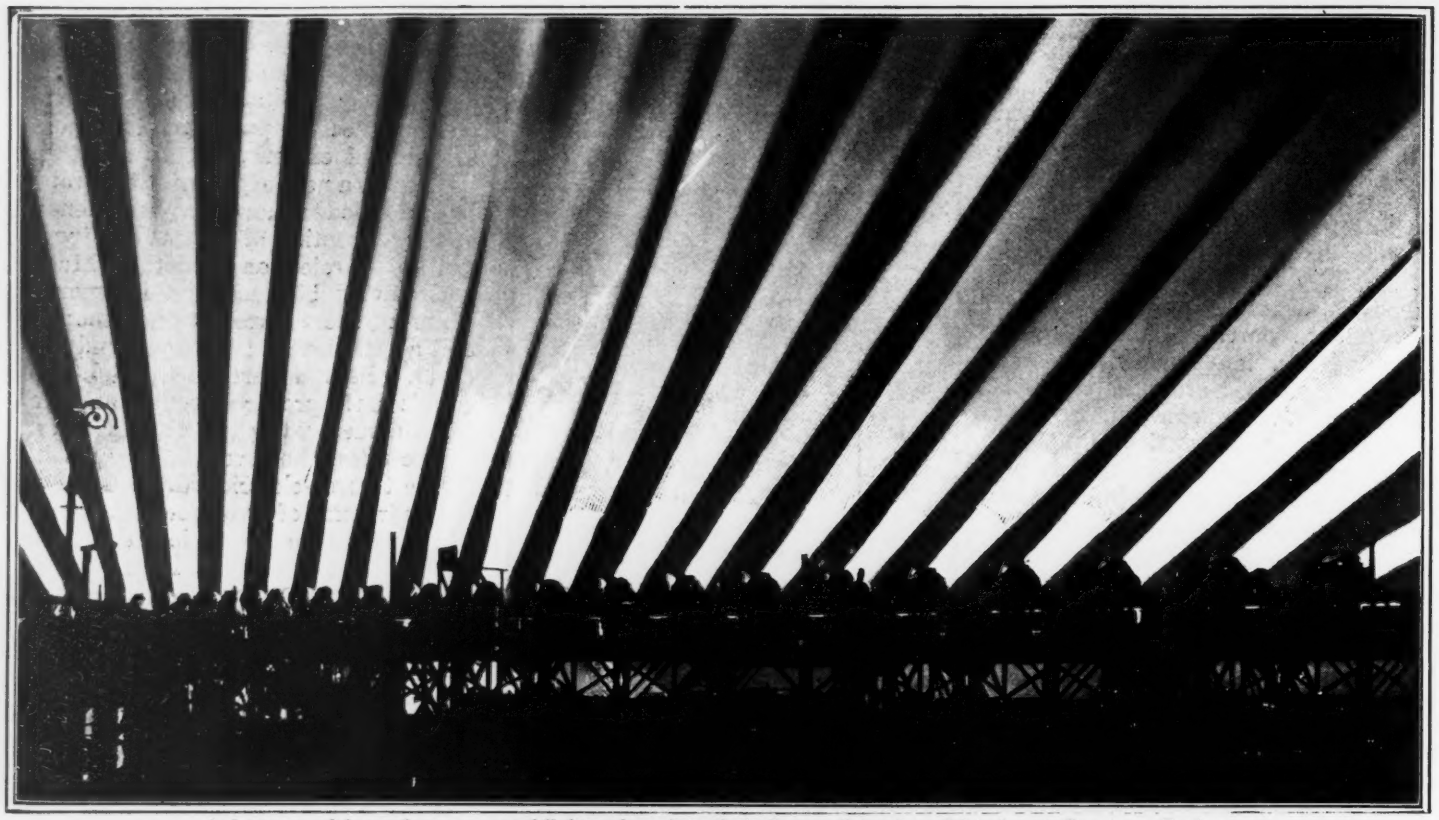
Is Electric Refrigeration Practicable?

It may well be, therefore, that we shall never see electric refrigeration. If we do, there will be formed a long circuit composed of alternate strips of bismuth and antimony for which the Peltier effect is greatest. This will be carefully insulated and folded up as shown in the picture, so that when a current is sent through it, all the junctions on one side are cooled, while all those on the other side are heated. The side that gets cooled will be put into the refrigerating chamber, and the other side left in the open air. Flanges to increase the radiating surface will be needed on the outside, and perhaps a running stream of cooling water as well.

This Tank Now Under New Management

TANKS are usually associated with rides more sinister than joy rides. But here is a tank that has been equipped to provide space for passengers who desire to travel over smooth and rough places in one of these capable though clumsy vehicles. A platform has been arranged for the top of the tank, thus increasing its space for passengers





A battery of incandescent searchlights throwing their beams into the night sky at Saratoga Springs

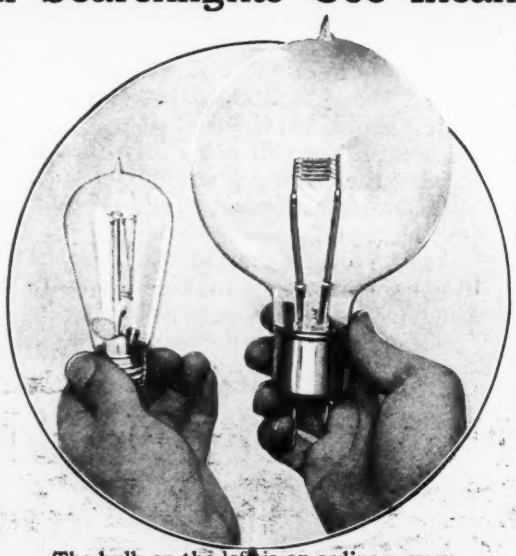
These Powerful Searchlights Use Incandescent Bulbs

"FIRELESS fireworks," the slogan for sane celebrations, have been made possible by a wonderful new incandescent searchlight. The beams of multicolored lights are projected through clouds of steam and the effect is as beautiful as that obtained with bursting rockets.

W. d'Arcy Ryan, illuminating engineer at Schenectady, and his coworkers in the laboratory, discovered a way to create a powerful point of illumination suitable for projection in a searchlight.

Many experiments were conducted before perfection was attained. Tungsten wire of various diameters, wound into helical loops, was tried in long and short coils, and finally the tests showed that three types were superior.

In a 115-volt current, 1000- to 1500-watt lamps produce from one to two million candlepower beams. But the most powerful of these lamps produces an illumination equal to twelve million candles. Imagine connecting the simple apparatus of this searchlight with your house current and projecting from your window a beam of light that would enable one to read a newspaper a mile away!



The bulb on the left is an ordinary vacuum tungsten type; that on the right is a gas-filled tungsten type. Gas-filled lamps are used for flood lighting outdoors

The convenience of this type of light is readily appreciated by river boats and coast stations. Beautiful effects of illuminating buildings externally are also obtained.

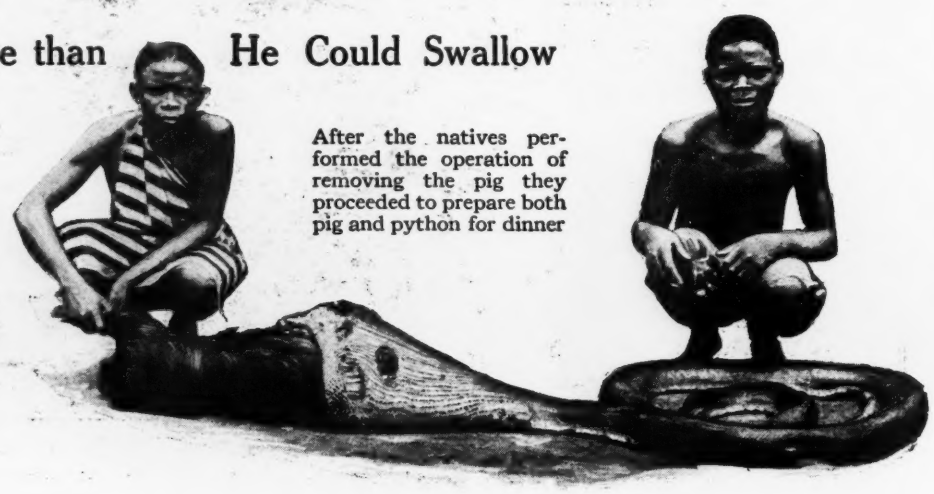
Spectacular color effects and beautiful ground and aerial displays have been worked out by Mr. Ryan for "fireless fireworks" that will furnish more variety and that will, in the end, be less expensive than the usual pyrotechnic display.

He Bit Off More than He Could Swallow

THAT one half the world does not know how the other half lives becomes pertinent when we think of people in civilization and those in remote jungle countries.

Some natives near the Congo set forth for adventure, and ran across a python that had just tried to swallow a pig. Once in a while a python's dinner is too big for the diner, and something must be done.

These native adventurers removed the obstructing pig from the monster's throat and appropriated it for themselves. Later they ate the python!



After the natives performed the operation of removing the pig they proceeded to prepare both pig and python for dinner

Soup and Fish in Paper Boxes

This latest method of preserving food does not destroy the vitamines necessary to health

By Latimer J. Wilson

WITH twenty-seven varieties of clear soups, thirty-one cream soups, twenty fish products, twenty-five meat products, and twenty different kinds of vegetables preserved to keep indefinitely, campers, explorers, and army men can be served rations convenient to carry and palatable to eat. A new process of food preservation, sponsored by Dr. William Edward Fitch, makes possible this extensive menu.

Dr. Fitch, who was a major in the United States Medical Corps, has given much time to the study of foods and their preservation. He has written three volumes on the subject, and has given considerable attention to those mysterious elements of natural foods called "vitamines."

These curious food-particles are found abundantly in the outer parts of cereals. When we throw away the husks of the wheat grain and make flour only out of the white substance of the grain, we throw away a vital part of the life- and growth-giving powers of the food.

When foods are heated or boiled to a high degree or for a long time, we kill the vitamines. No one knows much about vitamines. They are apparently crystalline substances with a rather high melting-point. If people eat food containing none of the vitamines, they will be subject to such diseases as beriberi, scurvy, and pellagra.

Germs in fresh meat, fruit, and vegetables must be kept from multiplying to such an extent that they make the food unfit for use. We say that food has "spoiled" when the bacteria that cause decay propagate with the aid of warmth and moisture. Contact with the air for a certain time produces conditions in which most of our foods spoil.

Sun-drying was the earliest known method of keeping meat and fruit from spoiling. "Jerked beef" (dried beef) was preserved in this manner. The process was too slow to be of commercial value. Hence it was not applicable to fruits and vegetables.

Then there is "smoking," applied to fish and meat, as well as salting, pickling, freezing, and finally, the process known as "sterilization." This is a perfect method of getting rid of all germs. But we do not want to kill them all. Some of the germs, and all the vitamines, are essential. Heating to a high degree of temperature destroys the bacteria and also the vitamines. The process of canning excludes the air successfully, but the heating destroys to a certain extent the vitamines.

Dr. Fitch's method consists in first cutting the fresh food in certain ways.

Food preserved by a new process, which retains the health-giving vitamines, is prepared by adding water and heating

Next the food is cooked. Then comes the patented part of the process, which consists in a series of dryings at very definite temperatures. Thus the putrefactive germs are destroyed, but the temperature has not been sufficiently high to harm the vitamines. The finished product can be left in contact with the air and no bad results follow, if care is taken to keep flies and worms from the exposed food.

Done up in small paper boxes, the preserved soup, broth, vegetable, meat, or fish can easily be carried about from place to place. All that is necessary is to portion out the required amount for a meal, mix it with water, and boil it for a brief interval. The original flavor is not destroyed.

The fresh food is cut into strips or thin slices, and is then subjected to a period of boiling at a limited degree of heat. Kettles, strainers, and the stoves upon which the boiling is done are shown

How It Will Look When It's Built

Carefully made models offer an excellent medium between architect and client

By H. Vandervoort Walsh

THE Architectural School of Columbia University is using a new method in teaching young architects how to design their buildings so that they will bear a rigid inspection.

The old way of learning to design in architecture was to make elaborate plans and elevations, and paint these in such a manner that even the designer could deceive himself into thinking he had a beautiful piece of architecture. Not so any more! He has to design his building on all sides, and make a model of the house and its surrounding gardens and landscape. He cannot deceive himself or others by pretty paintings, for his little model is a miniature of the design that he has created, and it looks exactly as the building would appear if actually built. And the big grown-up boys like to make these models just as much as they used to when they were kiddies in the nursery, playing with cut-out houses and blocks.

Students must use a great deal of ingenuity in making these models. Grass as green as the best in the spring is made from sawdust soaked in green dress-dye. Marvelous green shrubs are made out of rubber sponges dipped into green paint. Tall Lombardy poplar trees are excellently represented by fine sponges stained green and supported on the ends of wooden skewers. Little pools of water around the fountains seem very lifelike when they are made of looking-glasses on which are painted green pond-lily pads and white lily blossoms.

But the houses are the most fascinating of all. They are made of cardboard and of almost anything else, down to a toothpick for small columns. Before they begin work on the models, the students must submit sketches of the proposed buildings and layout. When these have been judged and the best selected, the students are divided into squads. Some, perhaps, will make the model little bungalows in a group; others will make a model for the great hotel; while still others will model the garden and surrounding landscape. The different parts are finally assembled.

Most of the houses are constructed from heavy cardboard. The various elevations are drawn and painted upon it, and then the parts are cut out by using cast-off safety-razor blades, which carve the material with ease. Many of the small projecting moldings are painted directly on the cardboard, and give all the appearance of real moldings. Larger projections are cut out of additional pieces and glued on. Roofs must be developed and glued together to secure the right pitch. Making the various parts join correctly is often very complicated.

Since the cardboard of which these models are made is illustration board, with heavy water-color paper mounted on both sides, the corners are easily made by filing the back or inside angle of the cardboard with a rat-tail file, reducing the material at this point and permitting the bending of the board without splitting it. Circular parts are cut from cardboard by a pair of dividers, one of the points of which has been filed down to a chisel edge.

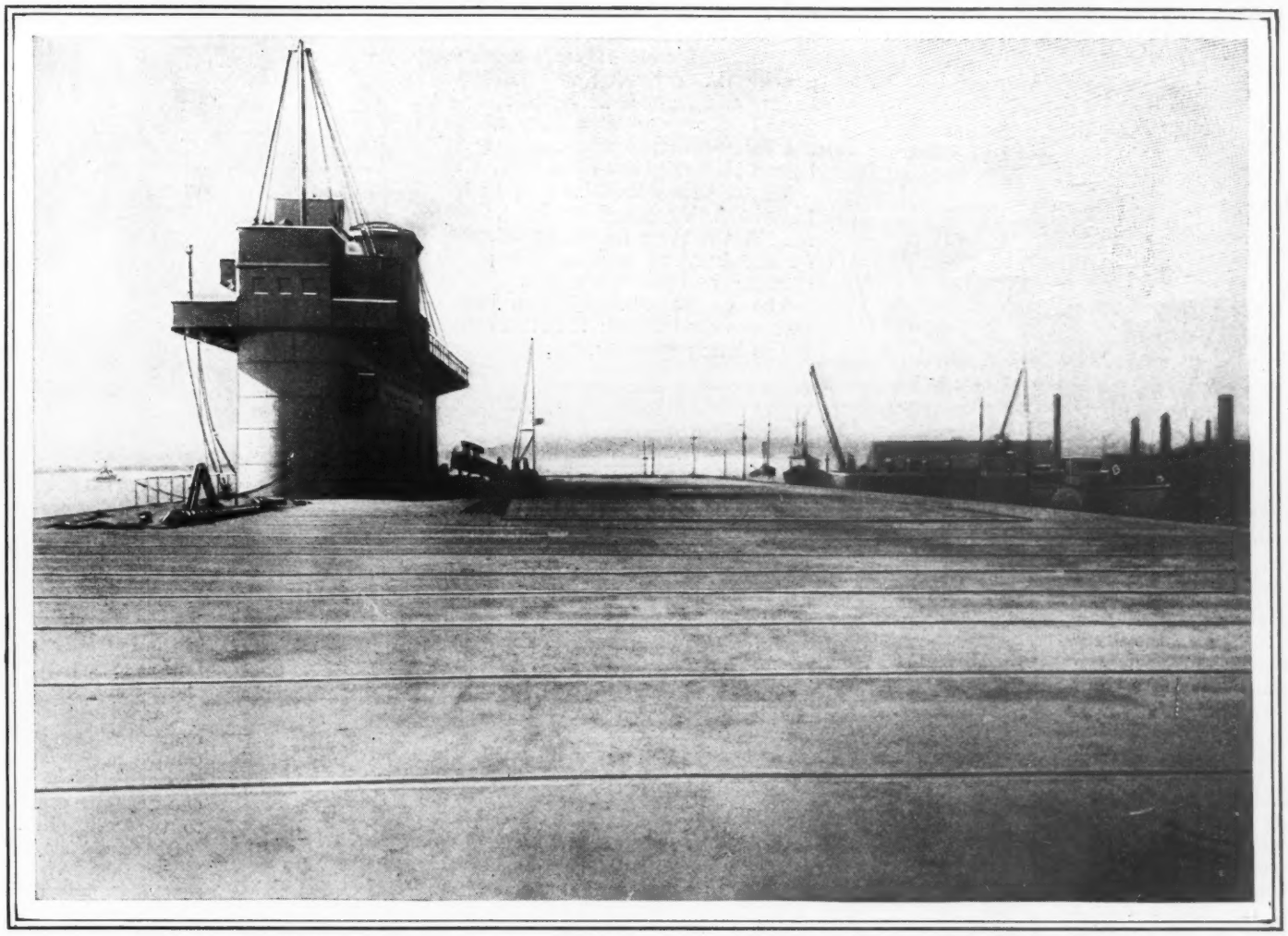
There are many odd tricks that can be resorted to in making these models, and it brings out all the ingenuity of the students. Director Boring of the school believes that all the architectural schools in the country will come to this method of teaching architecture in which the man is trained to see his building in three dimensions.

Of course most of the designing must be done on paper, but the two-dimensional training of paper architecture can be supplemented by introducing this system of study. Models provide a good medium for the architect to present ideas to his clients.

He is not a toymaker, but a student of architecture as it is now taught in Columbia University

These classic buildings are composed of cardboard covered on both sides with water-color paper; the shrubs are sponges dyed green, and the grass is of green sawdust

This Flying-Field is the Deck of a Ship



H. M. S. *Eagle*, of the British navy, is a mammoth aircraft-carrier. The flat upper deck was built for airplanes "taking off" and landing.

The displacement of the vessel is more than 30,000 tons. During the war it was in service, under the name of the *Almirante Cochrane*. Note the displacement of the bridges and smokestack from the center to the extreme edge of the starboard side

The war showed that a fleet is helpless without aircraft. While seaplanes have the advantage of being able to alight on water, they are not entirely satisfactory. Land machines have proved to be more so. But a great deal of space is required to accommodate these airships, more than a battleship can afford. Hence the *Eagle*, provided with a large flat deck, is one of the latest acquisitions of Great Britain's navy

September, 1920

One of the Newest Bicycle Models

THE wide sweeping handle-bars, the standing support attached to the rear wheel, and the deep frame illustrate how the bicycle is catching up to the motorcycle.

In front of the handle-bars is an electric searchlight, served from a dry-cell battery located in a case attached to the cross-bar. In the case is also a separate compartment for tools.

With its nonskid tires and a luggage carrier this bicycle is ready for the long, long trail.

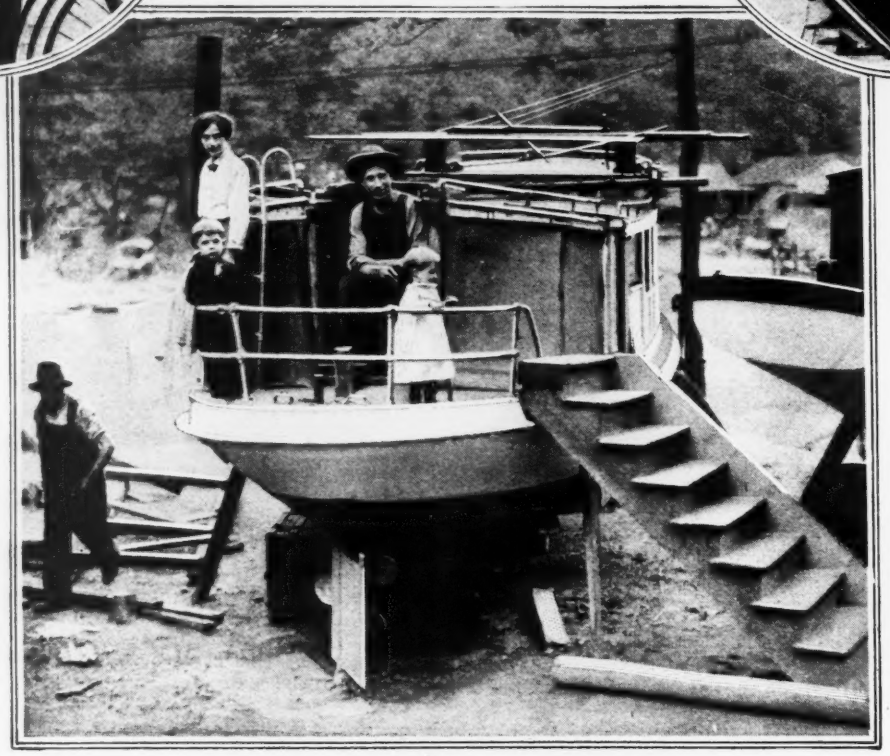
A Landworthy Little Boat

HIGH rents do not bother Vernon Newport, of Cleveland, and his wife and two children.

Newport, for fifteen years a cowpuncher in Wyoming and later a hunter and trapper in Nevada, arrived in Cleveland at a time when the house-shortage was acute, and he and his family lived in a tent.

Winter drove them out of that, but the father heard of a boat, frozen in the river ice, being offered for six hundred dollars. He purchased it and put it in shape.

The engine-room of the boat serves as the kitchen; the other cabins as living quarters.



Guns that Shoot Colored Fire

WHEN one of these pistols is discharged, a stream of colored fire shoots out of the barrel for a distance of about fifty feet.

Some pistols are loaded with Roman-candle fire-balls, and shoot a stream from one hundred and fifty to two hundred feet.

Obviously there is a long range of visibility to these shots of colored fire, and almost no limit to the code of signals that may be employed. They are used for signaling between airplanes in mid-air and the earth.

What Eighty-Nine Years Has Done to Railroads

EIGHTY-NINE years ago the tiny train pictured below was the very latest thing. Yet to-day the entire train, with its baggage and passenger coaches, is no longer than a modern locomotive.

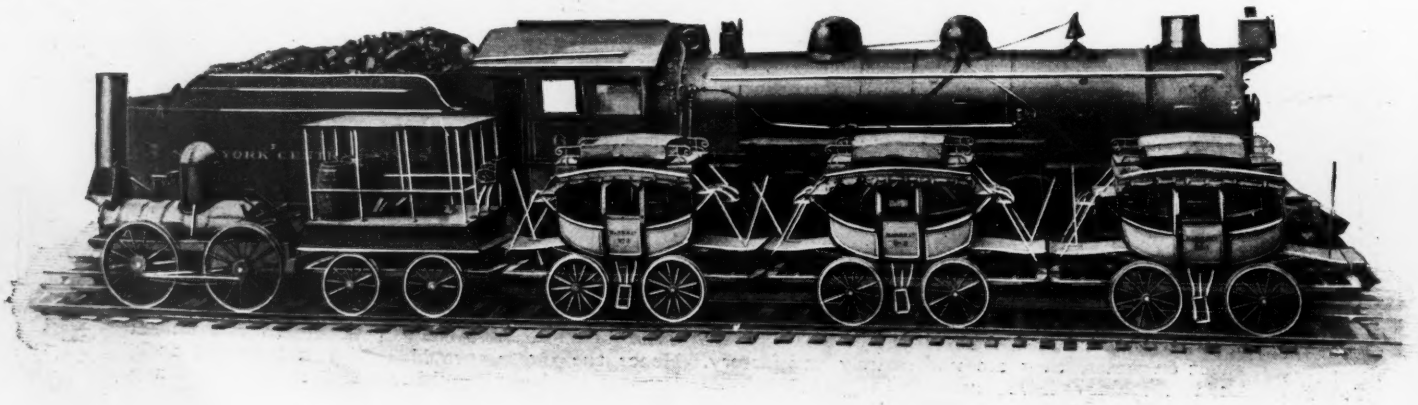
The train, known as the De Witt Clinton, was one of the first of its kind. On its trial trip coal was burned, but troubles developed that led to the reduction of the size of the smokestack and the relocation of the end of the exhaust-pipe. The troubles continued, and yellow pine was substituted for coal. The train ran better, but sparks flew out of the smokestack and showered on the passengers.

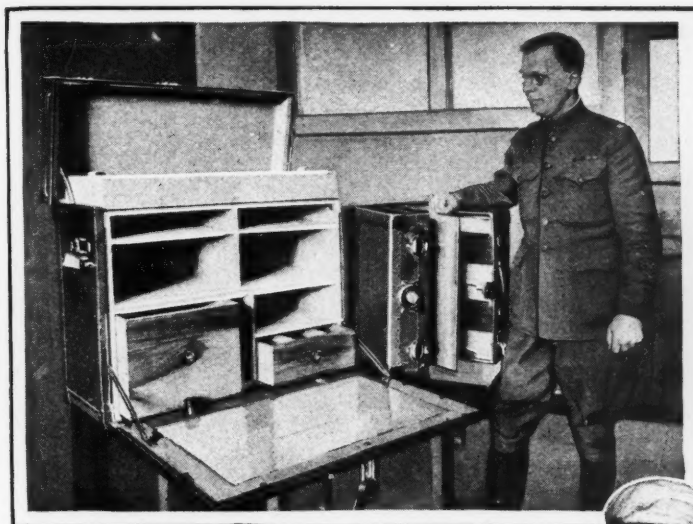
In spite of these difficulties, the De Witt Clinton managed to attain a speed of thirty miles an hour. It was rebuilt several times before it reached its final form.

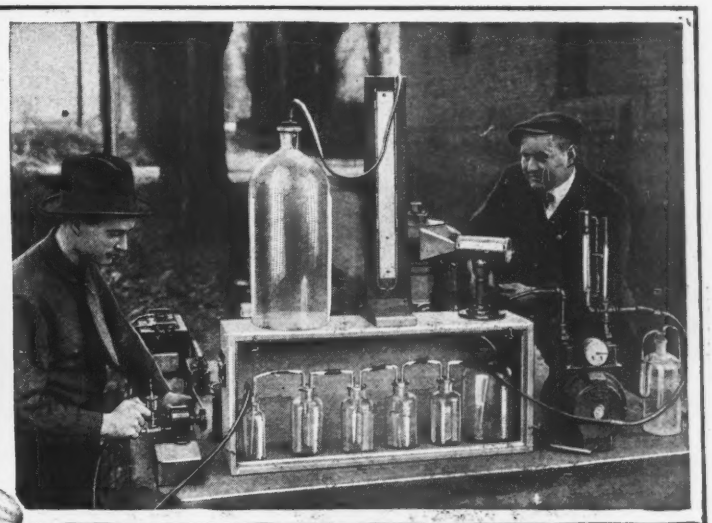
The engine is twelve feet ten inches long; its height to the top of the steam dome is eight feet five inches. The tender is nearly eleven feet long, and the coaches are fourteen feet long.

The train stands on exhibition in the Grand Central station, New York. And the tiny tracks it stands on are replicas of the ones on which it originally traveled, known as strap-rails.

At the same time that the De Witt Clinton was being developed in America, similar steam locomotives were constructed in England. They were not as speedy as the De Witt Clinton, but they carried much heavier loads. One English engine, for instance, carried a trainload weighing ninety-two tons at the rate of five miles an hour!







Turning Field Desks into Trunks

INNUMERABLE newly made field desks never got to an army camp before the armistice was declared. And they are still waiting around for some one to use them. Now the government has decided to sell twenty-seven thousand of them.

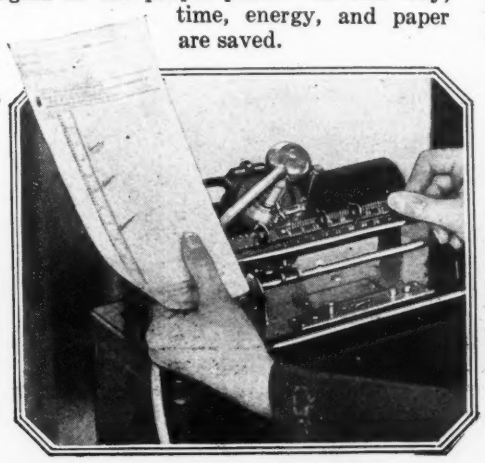
When the partitions are taken out, these desks become strong trunks. They are covered with vulcanized hard rubber that is given two coats of water-proof varnish, and are carefully made throughout. The trunks should last a lifetime.

They are made in two sizes: the large one is thirty-one inches long, twenty-six inches wide, and fourteen and a half inches deep; it weighs sixty-three pounds. The smaller one is nineteen and a half inches long, sixteen and a half inches wide, and nine inches deep; it weighs twenty-five pounds.

A Detector of Dictaphone Errors

TAKING compassion on the dictaphone operator, Miss Alma Zaiss, of Kansas City, Missouri, has invented an error indicator.

The dictaphone's measuring-board is notched, and the operator places the stops to correspond with the corrections on the chart, which indicate where the *error* begins; not the correction. When the dictaphone pointer comes in contact with these stops, a bell attached to the pointer rings; the operator knows the omitted part has been reached. She stops typing, listens to the deleted portion, and begins again at the proper place. In this way, time, energy, and paper are saved.



Grow Your Own Varnish

HAVE you ever seen the varnish-nut? If not, look at the picture above. Seven nuts may be seen in the hands of the young lady who is sitting down. Of course, this isn't the kind of varnish we buy in tin cans; nevertheless it is an excellent substitute, and has been used in China for many years.

The trees on which these seven nuts grew were imported from China to Santa Ana, California, twelve years ago. They are tall, graceful evergreens, and have been used solely as ornaments. The nuts, filled with the sticky varnish, have been allowed to fall and rot.

China and Japan are not so wasteful. They coat their furniture, pictures, and fancy woodwork with this inexpensive fluid. One picture, more than four hundred years old, is supposed to have been preserved throughout the years by constant application of this nut varnish.

The varnish-trees in California spread over ten acres. They bear a great number of nuts each year, and a large quantity of varnish could be collected from them. It seems strange that this has not yet been done.

"Smeltery Not Guilty," Says the Airplane

FOR years inhabitants of Salt Lake City, Utah, have accepted the theory that a smeltery, located about seven miles away, has been the source of a disagreeable smoke that has hovered over the city. The people have thought that the smoke from the smelting plant was heavier than coal smoke.

To find out whether or not this was true, a chemist who formerly served in the aircraft division of the army took to the air. With the aid of a vacuum bottle he collected a quantity of the smoky atmosphere immediately above the city.

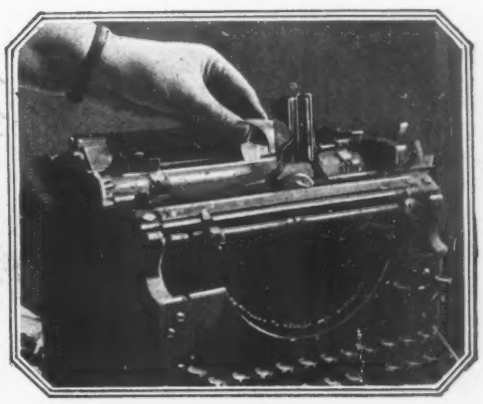
The subsequent chemical analysis disproved the accepted opinion that the coal smoke was less dense than fumes from the smeltery; no trace of an atmosphere beclouded by fumes from the sulphur furnaces was present. Consequently Salt Lake City will have to blame something else.

Renewing Typewriter Ribbons

DON'T throw away your typewriter ribbon when it becomes pale from loss of ink. There is now a device that will rejuvenate an old ribbon so that you can continue to use it for a long time.

You release the ribbon from its central holder—not from the wheels—and then run it through a pair of rollers, part of the device. A thin stream of ink oozes out as the rollers turn and it thoroughly saturates the ribbon.

The rejuvenator is fastened to the platen of the machine by means of a small spring.



Photograph from United States Forest Service

She Has Written Millions of Checks

TO Miss Annie Belew of Del Ray, Virginia, belongs the distinction of being the speediest operator of a graphetype machine in the world. She is an employee of the disbursing division of the War Risk Insurance Bureau, where she recently outdistanced one hundred contestants in spirited rivalry for first place.

What is a graphetype? A machine that prints numbers on checks. This particular one has disbursed War Risk Insurance Bureau checks to approximately five million insurance-policy holders and fifteen thousand employees.

Miss Belew has established the record of completing the numbering process on seventy-five checks an hour by the operation of this machine, which resembles a cross between a washing-machine and a cream-separator. It produces a noise like a compounded beehive and an electric riveter. Coordination of nimble fingers and a quick-acting brain is the winning combination.

Cast Your Bed on the Waters

VERY much like a washboard is this new surf-coaster. It is made of metal tubes joined together and forming a corrugated surface. The tubes are filled with air and are sufficiently buoyant to ride on top of the waves and breakers.

The inventor of this device—H. B. Marshall, of Long Beach, California—calls it a "mattress." After all, it is a sort of mattress; you lie upon it. The surf-coaster can be bought in many sizes.

Spare the Trees and Sign the Register

FREQUENTLY a tourist will carve his name on the nearest tree every time he stops anywhere. He evidently wants the world to know that a distinguished visitor has been there.

Would it not be much simpler and less detrimental to the trees for him to sign a register instead?

In the White River National Park, Colorado, registers like the one above are provided; thus the trees are spared such senseless mutilation.

Tenting on the Accommodating Back of a Camel

OWING to the camel's accommodating back, Arabian women can cross the desert in comfort. A tent is strapped around the camel's hump and inside it are placed cushioned seats. So the women are protected from the intense heat of the sun. The men walk at the side of the camel to guide him. Thus, you see, Arabian women are not considered inferior to men. They often enter the business world, and in time of war they even lead regiments into battle.

The picture to the right shows the camel resting after a long journey. The two passengers have emerged for air. It seems strange that an animal having as thin legs as the camel can carry heavy burdens across many hot miles of desert. But it is peculiarly adapted for life in the desert. The soles of its feet are very callous and the heat of the sand does not bother it. Camels eat thorny desert growths and carry water with them.

An ordinary camel will travel twenty-five miles a day; the fleeter breeds are capable of covering fifty miles a day for five days without drinking.

The Swatter that Kills and Swallows Them

CONSTANTLY we are told to swat that fly. Here's something new to swat it with—a swatter that stuns and then swallows the fly.

The handle of this swatter is hollow, and the screen at the top is made in two sections, with a small space between. The center is cut out of one of the sections. This is the section that faces front when you swat.

Thus the fly is simply stunned. It drops between the two sections and lands in the handle, the corpse and evidence being thus completely hidden.

When you have obtained a handleful of flies, you dump them out and begin again.

A Giant among Pots with a House of Its Own

WHOEVER heard of a pot large enough to have a special house built for it? The inhabitants of Bunzlau, Germany, have.

A potter named Gottlieb Joppe labored for months over the molding of the pot displayed in the picture below. It is about twelve feet high and six feet in circumference. It tips the scale at twelve hundred pounds. Quite a hefty pot!

Such a pot could not be placed upon the pantry shelf, like other pots; so a special house was built to hold it.

Swatting by Means of a Vacuum Cleaner

BY the end of the summer your fly-swatter is usually worn out and the joy of killing flies has turned to monotony. The flies have become stupid and they don't put up a fight; they simply stand still and let you swat them.

Then is the time for you to get out your vacuum cleaner. Run it along the walls and doors, as shown in the illustration, and the flies will be swallowed alive.

Vacuum cleaners, as their name implies, were originally meant for cleaning. But they have since been put to many other uses—drying, for instance. The force of the draft will cause the molecules of liquid to evaporate more rapidly than usual; in other words, a wet article can be more quickly dried.

This Battle Cruiser Is Mother to the Mine-Sweepers

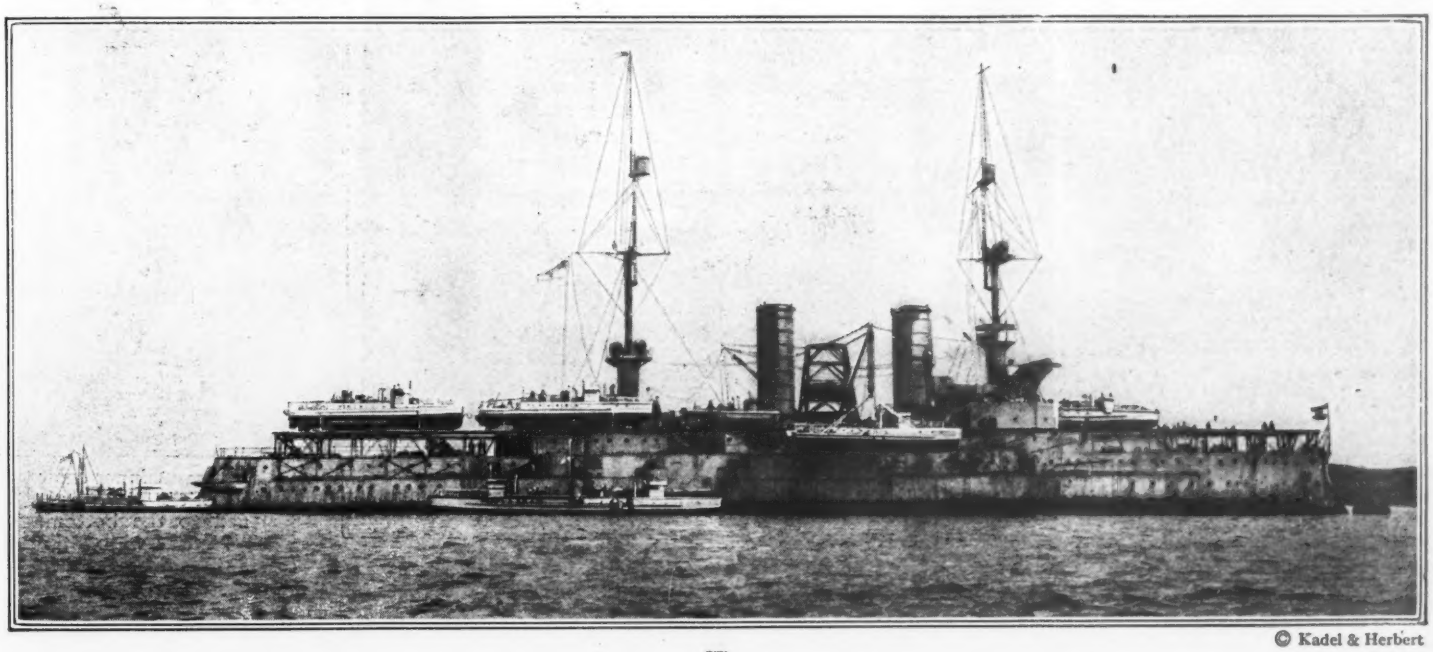
SEAPLANES have their mother ships, and now mine-sweepers have them too—that is, German mine-sweepers.

In the picture below you see the *Wittelsbach*, an old battle cruiser that has but recently been converted into such a mother ship.

She can now accommodate twelve small mine-sweepers on her decks. There are also on deck huge cranes for picking up the mine-sweepers and lowering them to the water.

When the sweepers return at the end of a day's work, the cranes reach down and pick them out of the water with hardly an effort.

In the picture of the *Wittelsbach* shown herewith you can see four of the sweepers in their places on deck. Two more are still in the water, ready to be lifted up to the ship's decks, as a cat lifts her kittens and carries them one by one to the corner that is their home, taking them out of harm's way.

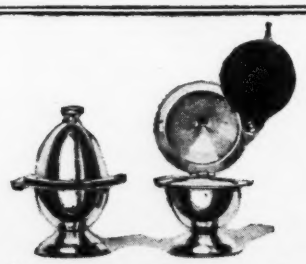


© Kadel & Herbert

Housekeeping Made Easy

Instead of a clock, put your watch in a folding stand with a magnifying-glass

The notched inner surfaces of these clothespins give them added strength

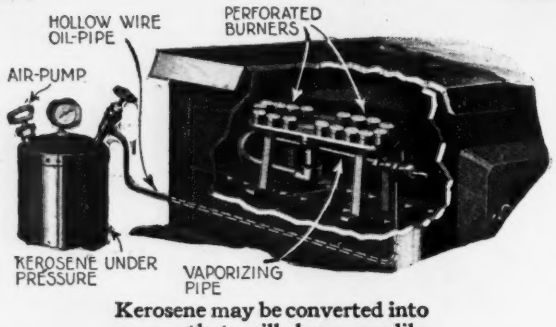


An egg-cup that beheads eggs. You place the egg, close the cover, and give the sharp-edged slide a sharp pull

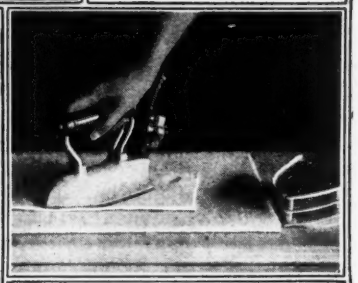
Coffee-pots usually have wooden handles; protect them from the flame by small metal shields

A milk-bottle handle is attached to a cover, kept in place by three prongs that fit the top tightly

You grasp the handle of this potato-peeler, peel with the two sharp blades, and dig out the spots with the sharp pointed end

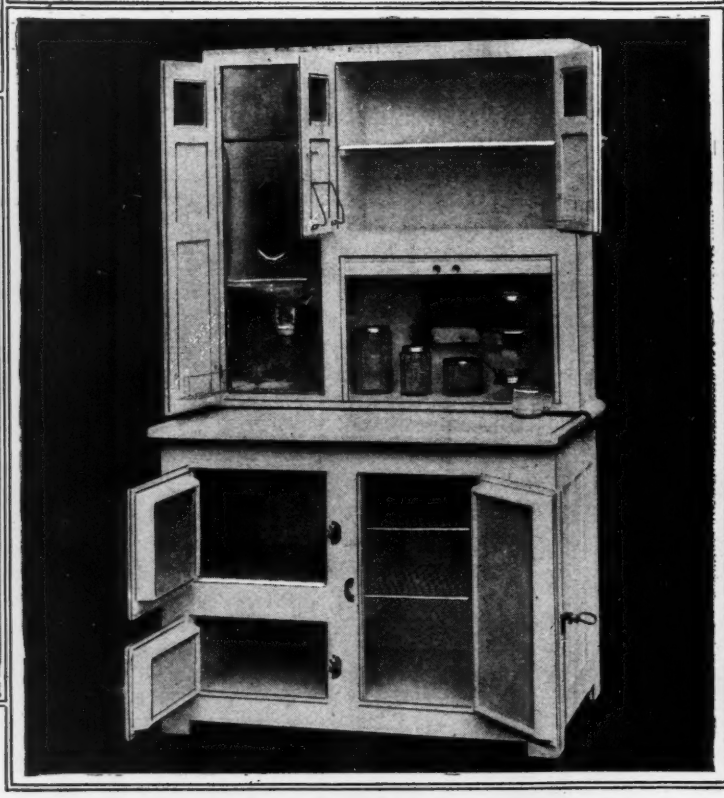


Kerosene may be converted into a gas that will burn readily



A folding cardboard ironing-board that will fit any trunk is useful when traveling. It is covered with flannel and fits in a case

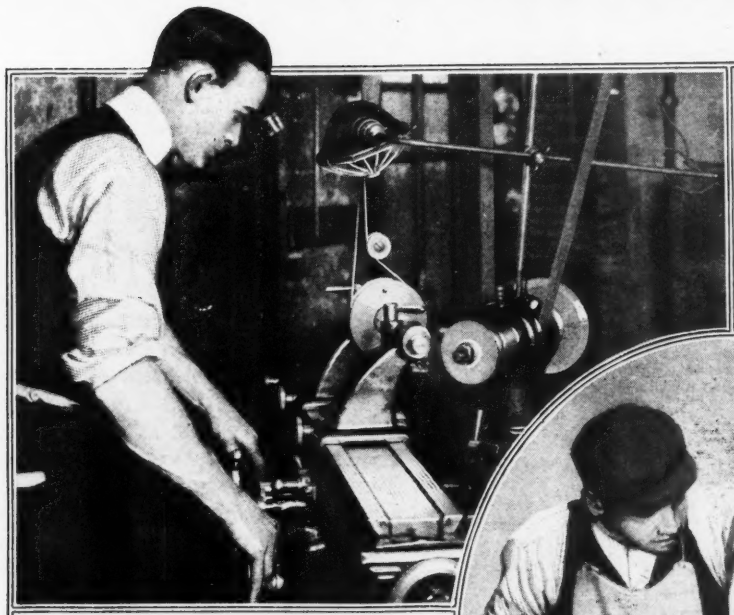
Put not your ice in lemonade; put it in a container and the container in the pitcher. The ice cools the lemonade without diluting it



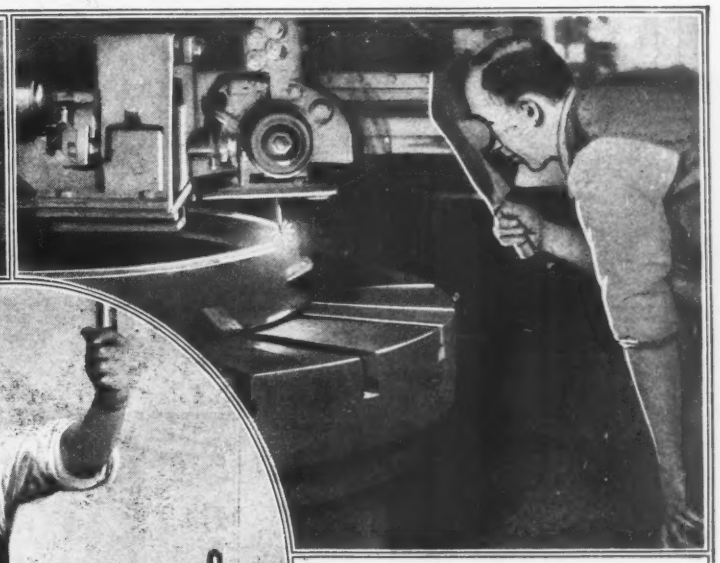
A kitchen cabinet and icebox combined; the icebox occupies the lower story. The whole saves space

This cream-whipper can't slip out of the bowl; it is fastened to the bottom. The blades whip the cream in thirty seconds

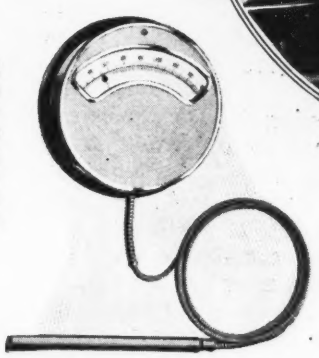
Do It with Tools and Machines



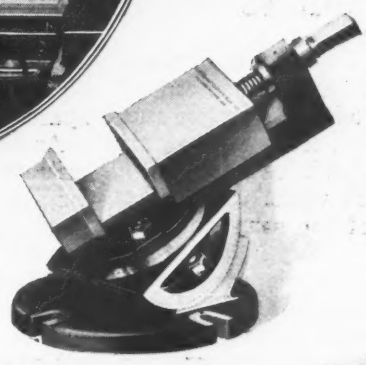
A new lighting fixture can be turned and clamped in whatever direction desired by the machinist. An invaluable addition to the factory's equipment



This electric welding-machine is used where a quantity of routine welding is done. It is said to have from two to six times the speed achieved by hand



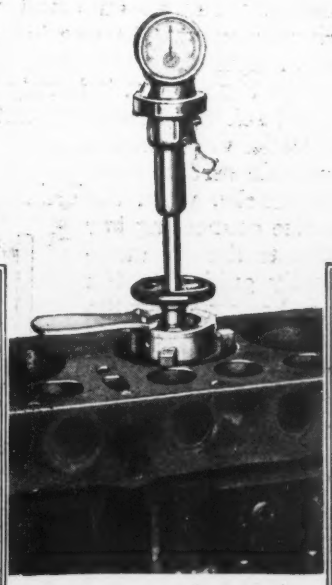
This indicating thermometer has a capillary tube connecting the bulb and the indicating gage. It tests temperatures to 800° Fahrenheit



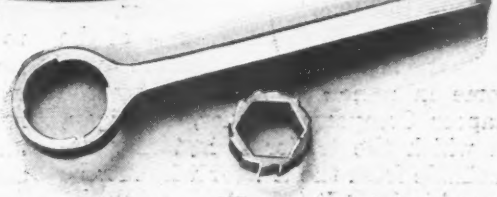
A four-in-one changeable drill-head, designed to accommodate four tools. It requires but a moment to release a lock switch and to change one tool for another

A vise that gives you any angle desired. It swivels 360° horizontally, and 100° vertically. It is low and rigid and has unlimited possibilities

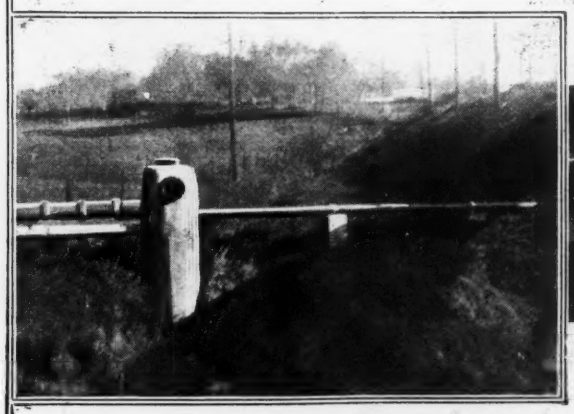
This draft-gage is used in plants to measure the draft in chimneys, ovens, kilns, etc.



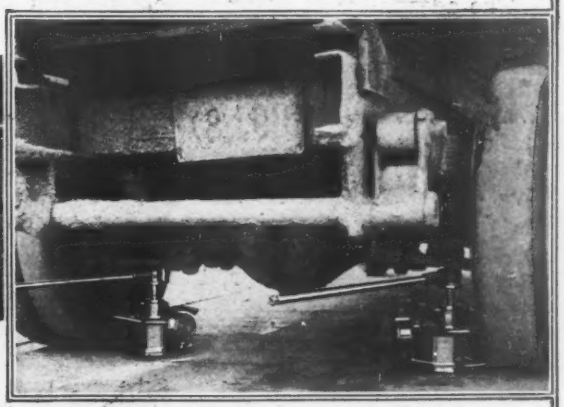
Variations in the diameters of cylinders can be detected readily by this gage. The measurements are recorded on a dial



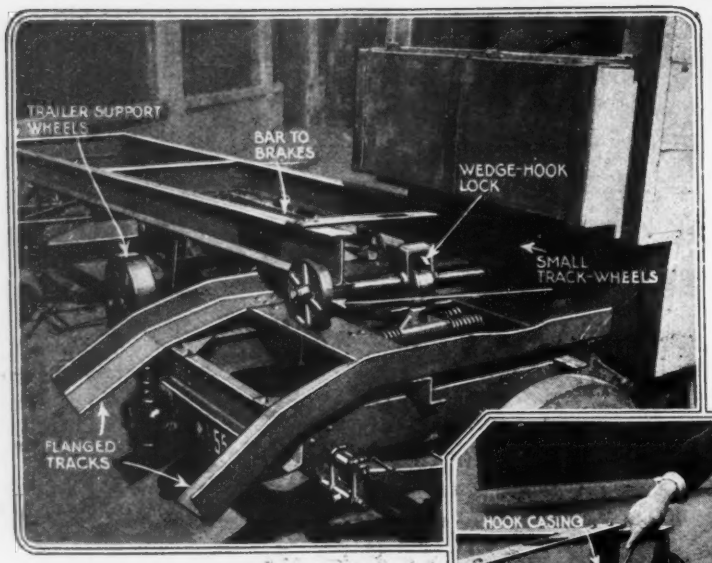
This wrench acts as a ratchet as well, and can be used on any size and shape nut



An economical sewer-pipe. An 18-in. pipe runs into the overflow manhole. From thence an 8-in. pipe carries away the sewage



The loadmeter tells if a truck is overloaded. The rear wheels are jacked up and the gage-reading tells the load



The tractor is reversed until the small trailer wheels guide the tractor hook into its catch

A hinged pair of wheels swings underneath the trailer frame, making it easily transportable without the tractor

Truck Trailers Made Instantly Detachable

EFFICIENCY in the use of trailers behind motor-trucks is sometimes offset if it takes too long to couple and uncouple the trailers from the towing trucks or tractors. With the ordinary type of wagon fifth wheel to connect the forward end of the semitrailer to the tractor, the upper half of the fifth wheel must be placed exactly above the lower half before the king-pin connecting the two can be inserted to hold the two halves together.

Both of these disadvantages of the ordinary type of semitrailer are overcome in a new type, made by the Lapeer Company, Lapeer, Michigan, in which the trailer is instantly detachable from the tractor without the use of jacks. It is portable when detached and has brakes to assist those on the tractor and prevent serious side sway.

The advantage of being detachable without the use of jacks is obtained by fitting a pair of wheels on a hinged support underneath the trailer frame. When it is desired to detach the trailer, these wheels are swung downward into contact with the ground so that the trailer and its load may be moved to another point if desired. The hinged framework carrying the small front wheels has a rod attached to it which automatically sets the brakes on the rear trailer wheels so that the trailer cannot move of its own accord and cannot be pulled unless a handle underneath the trailer at the rear is turned through an angle of 180 degrees.

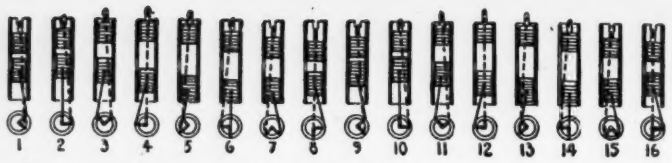
This lever is also connected with the mechanism which holds the trailer to the tractor, and the trailer brakes must be set before the two can be moved apart.

As shown in the accompanying illustrations, this is accomplished by a longitudinal rod between the side-frame members of the trailer, which act as a wedge between the top of the hook on the tractor and a casting carried on a crosswise shaft near the front of the trailer frame.

For quick connection of the trailer to the tractor, the forward end of the former is mounted on small wheels which run on two flare-ended tracks mounted on the tractor frame. Thus to make the connection, it is only necessary to back the tractor up until the small trailer wheels strike the outside vertical sides of the tracks, when the crosswise connecting bar on the trailer is automatically guided to the tractor hook without the necessity of a series of intricate maneuvers.

To take up the strain in starting and stopping, the tractor hook is mounted on a casting carried on two horizontal, longitudinal shafts fitted with coil-springs at the ends.

The tractor hook is pivoted so that the trailer may be turned at right angles to the tractor when turning corners or when backed up to a curb to unload.



Showing the engine cycle. 1, beginning intake stroke; at 6 the pistons are approaching each other; the spark occurs at 9; the exhaust stroke begins at 12 and ends at 14; 15, 16, cycle repeats

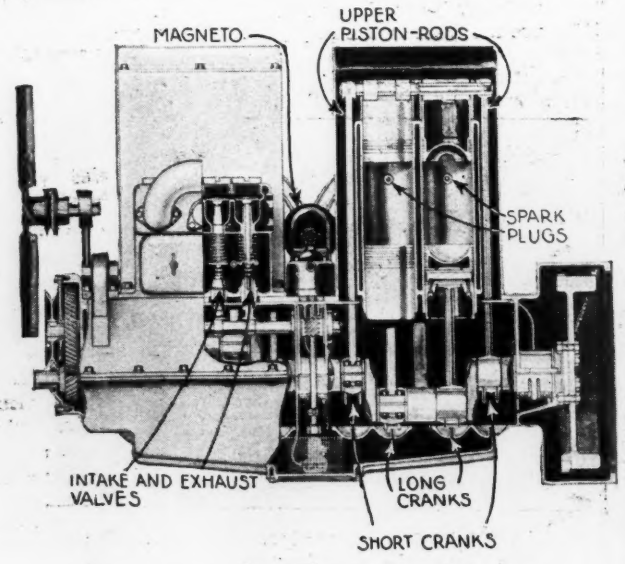
Two Pistons in One Cylinder

BETTER balance, less valve-warping, and the ability to burn low-grade fuels are the outstanding characteristics of a new type of motor-truck and tractor-engine perfected by T. G. Jackson of Chicago. The engine differs from the conventional type of four-cycle engine in that two pistons, one above the other, are employed in each cylinder. Both pistons are reciprocated by their own connecting rods and move toward and away from each other. The heads of the pistons are sunken in a hemispherical form so at the moment of explosion the shape of the combustion space is spherical. The pressure of the explosion is exerted directly against the heads of the piston. One spark-plug is used in each cylinder and is provided with an extended shell.

By this placing of the pistons, the intake and exhaust valves are located low down on the cylinder in a chamber of their own so that they are never in contact with the hot gases at the moment of ignition.

In this new engine, all the driving force of the gases is applied through the reciprocal parts to the crankshaft.

Better balance is obtained by the upper piston pulling up while the lower piston pulls down. The main bearings thus support only the weight of the crankshaft and flywheel and the power of each explosion is utilized to the full.



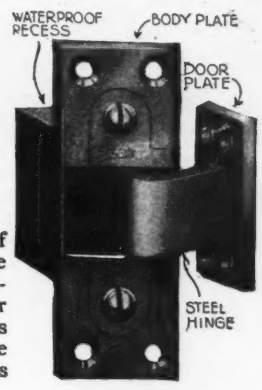
These cross-sectional views of the engine show the general arrangement of the component parts and the position of the pistons and crankshaft

Here Is an Invisible Door-Hinge for Automobiles

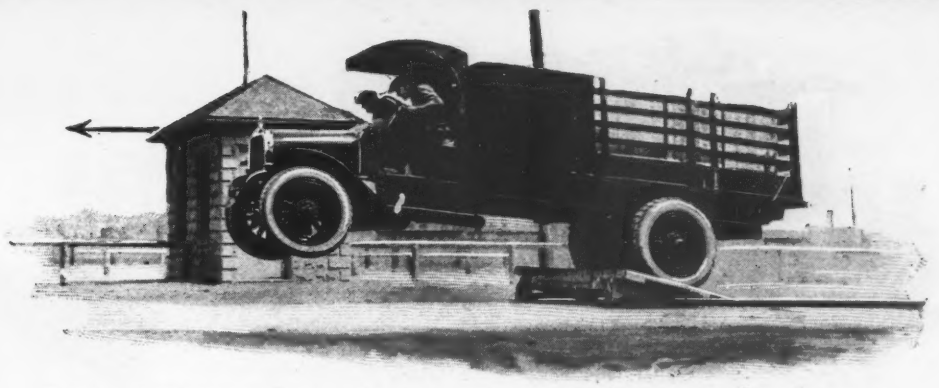
ONE of the little things and yet one of the refinements that go to make up a high-class automobile are the seemingly insignificant door-hinges. If you have driven an automobile, you know that hinges are an annoyance if they work loose and cause a rattle while the car is in motion. Then again, if they wear by rusting, they leave an unsightly crack between the jamb of the door and the side of the body proper.

These drawbacks are eliminated in the new hinge shown herewith; also the new type is invisible when the door is closed, and has no protruding parts to catch in the clothes of those entering or leaving the car.

The hinge is made invisible by a pocket in the hinge support. By an arrangement of hinge pivot and a curved hinge hook, the latter folds up entirely inside the pocket.



This type of invisible hinge for the automobile door eliminates outside hinge drawbacks



Truck manufacturers spare no expense when testing pneumatic tires; these are now being widely used for obtaining speed in long-distance hauls with heavy loads

Taking an Eighteen-Foot Test Jump

BY making a motor-truck jump eighteen feet through the air, it has been found that a pneumatic truck tire is four times as resilient as a solid tire. Until a series of such jumping tests was made, no one knew what happened when a loaded truck climbed a curb, dropped off an elevation, or bumped over a railroad track.

But thanks to the fast-moving motion-picture machine with the pictures projected 16 instead of 160 times a second, tire deflection, frame weave, and spring action can be measured.

A thrilling experiment was that in which a two-ton truck, weighing 6400 pounds and carrying a load of 4400 pounds (total weight of 10,800 pounds), was run under full headway on an asphalt pavement, and then made to mount a sharp incline eighteen inches high. When it hit the incline, it was traveling twenty miles an hour and jumped eighteen feet clear through the air before it again struck the ground. The illustration shows it completing its jump.

Learn How to Fight Automobile Fires

PERHAPS few of us would be foolish enough to throw water on a gasoline fire; yet we recently read of just such a case, and the result was that the water spread the flames to such an extent that the automobile soon was enveloped.

Every well equipped automobile should be supplied with a fire-extinguisher of the hand-pump variety.

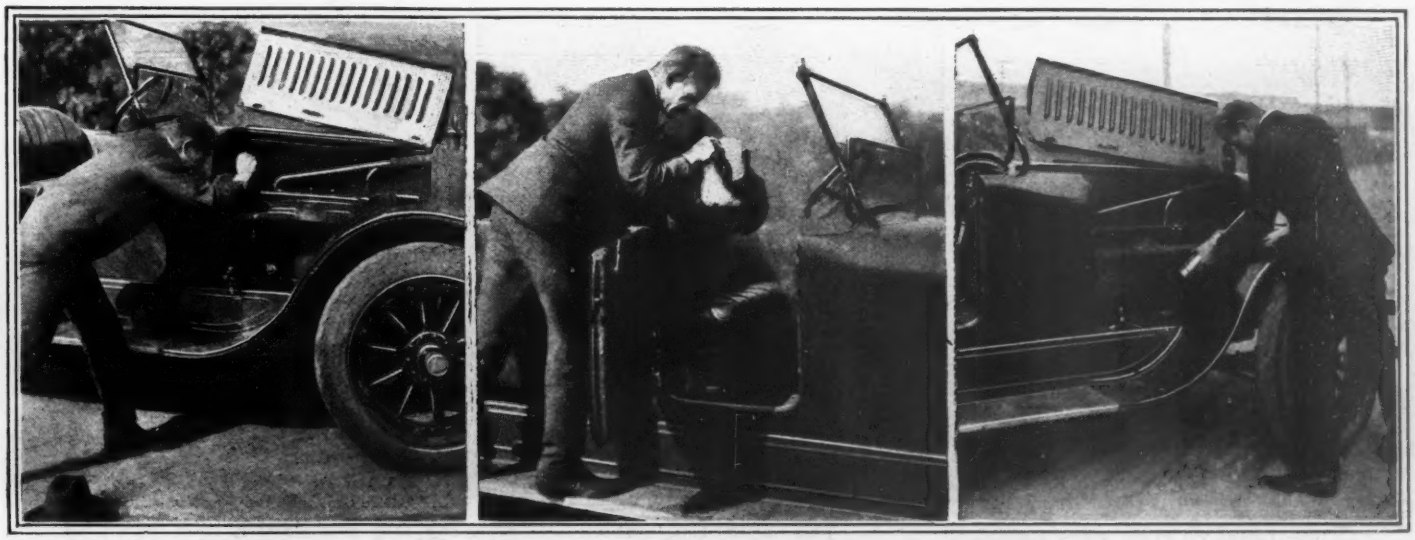
If you see flames coming from your automobile, the first thing to do is to stop—stop quickly, and get all of the occupants out of the automobile as fast as possible, because there is always the danger of an explosion. Then seize the fire-extinguisher and try to ascertain the source of the flame, so as to direct the chemical on its base.

You must keep the flame away from the gasoline. When the fuel catches fire, it is time to watch out. Often it is dangerous even to lift the hood, because in so doing you allow the flames to burst forth.

If you have no extinguisher, take sand from the road and dash it on the flames, or smother the fire with the lap-robe.

The best thing to do, however, is to take ample precautions against fires, such as a periodical inspection of the electrical wiring to see that none of the cables is touching any part of the power plant that is likely to get very hot. See to it, also, that your motor does not overheat due to a lack of oil or water.

Above all, if you do have a fire, *act quickly*. Always hold yourself in readiness for any emergency.



A fire-extinguisher should be an essential part of the equipment of every automobile

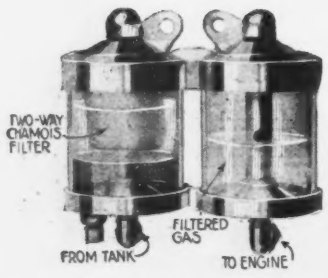
If the carburetor back-fires and ignites, sand is effective. It must be removed afterward

A robe may be used to smother the flames in the absence of a fire-extinguisher

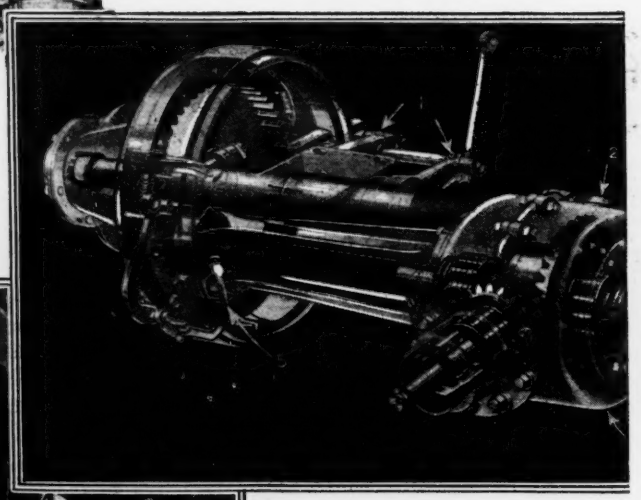
Big and Little

Accessories that are

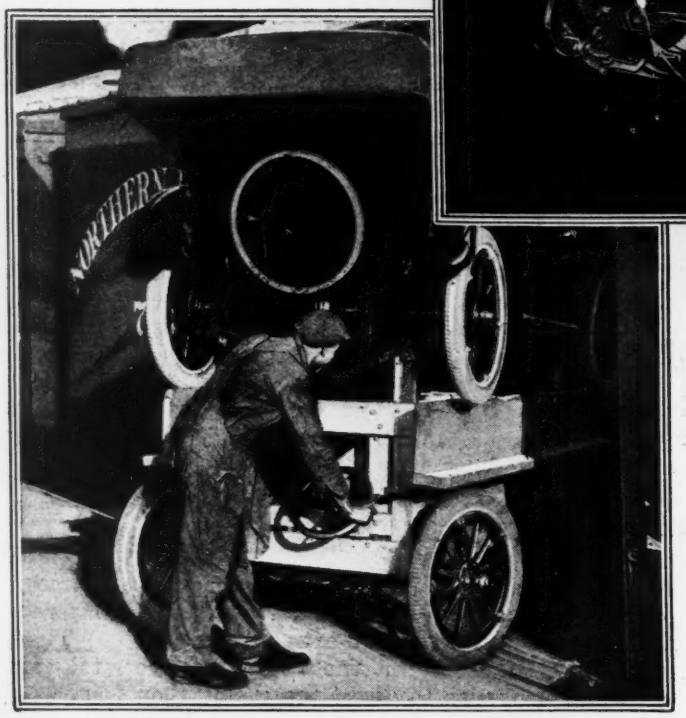
With removable crosswise seats on a two-wheeled trailer this convertible truck is used in Ireland to haul its human cargo to and from work



This is a filter that absolutely prevents water, rust, accumulated dirt, and foreign matter from reaching the delicate mechanism of the automobile engine



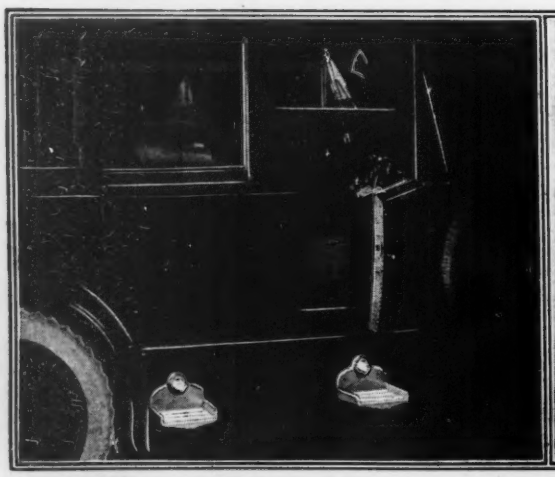
Hoping to reduce mechanical troubles, an axle company prepared an illustration showing



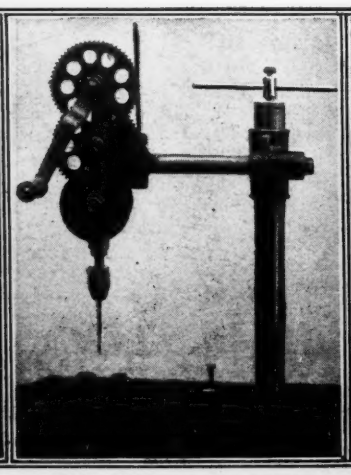
In Europe people ride in air-propelled tri-cars. The propeller is protected by a metal frame. The motor and gasoline tank are behind the driver

A new automobile jack for freighting lifts an automobile enough to be shunted over another one, making two tiers of automobiles in one car

A hand-pump that can be screwed easily into the top of the oil-barrel



The lamps on these steps automatically light as the doors are opened, and go out when the doors are closed. This feature will be appreciated by many

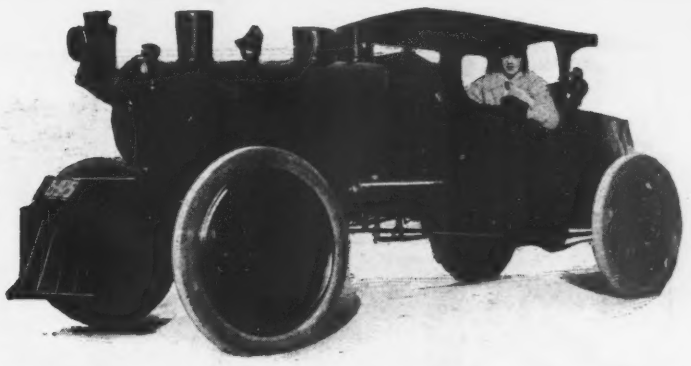


This little tool embodies a vise, a drill, a saw, and a grinding-stone. Useful for the home garage

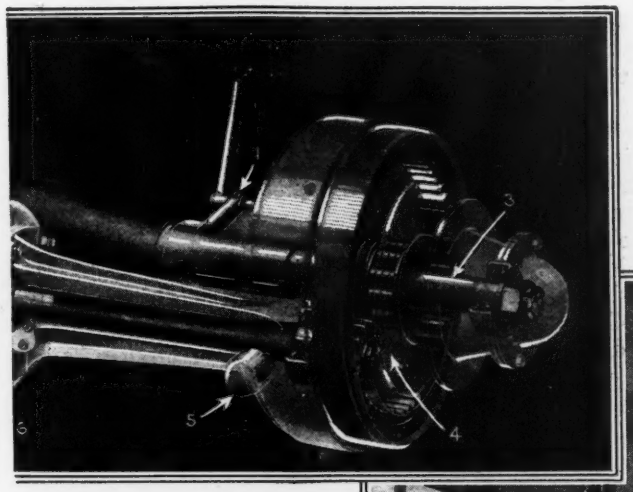
The only gear-shifting lever lock that locks the gears of a car in neutral position. It forces a plunger between gear-shifting forks and has a standard lock

Automobile Parts

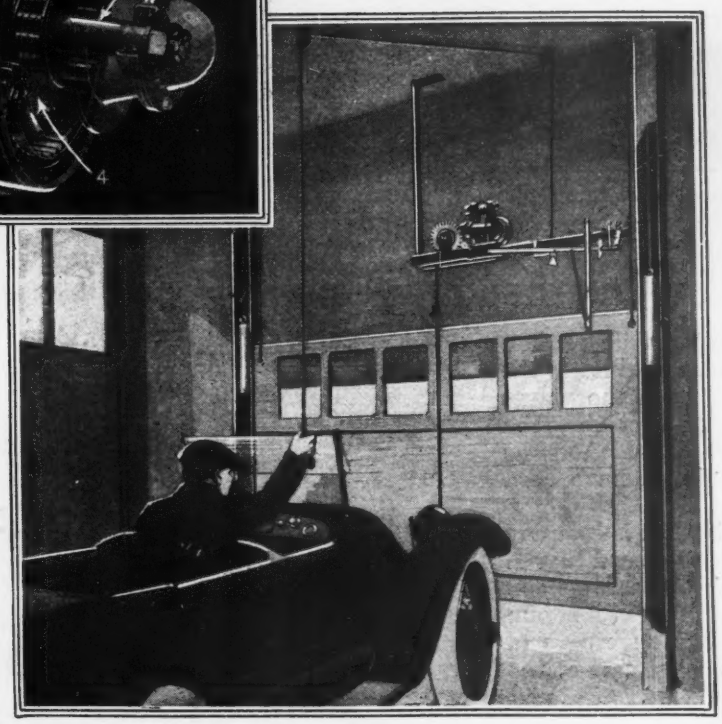
useful and economical



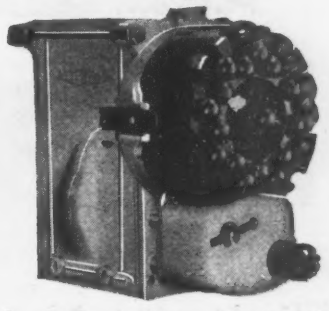
The motorotive combines three automobiles, a steamer and two gasoline cars. On the stretches it can make 78 miles an hour



the mechanism of an axle in detail. The numbers indicate the parts to be lubricated

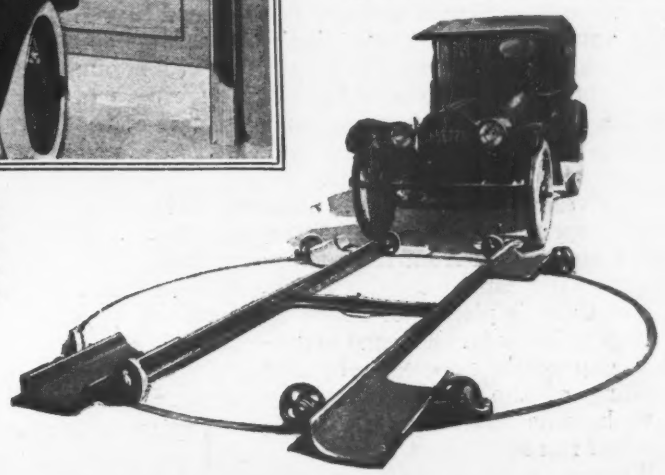


By merely pulling a cord, and without alighting, one can now open the garage-door if it is equipped with this new opening device. An electric motor slides the door open

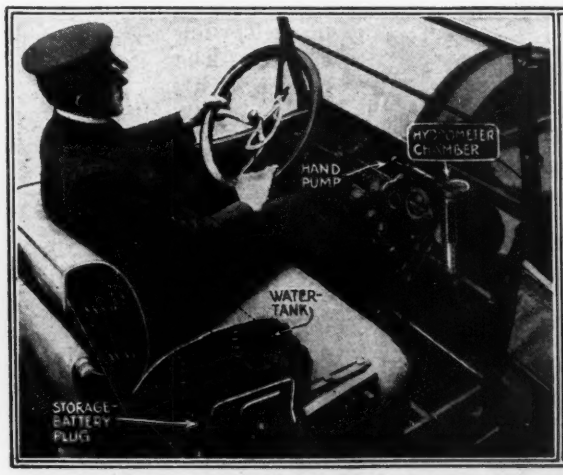


A single ignition instrument which will serve eighteen cylinders. The magneto produces over 20,000 sparks a minute

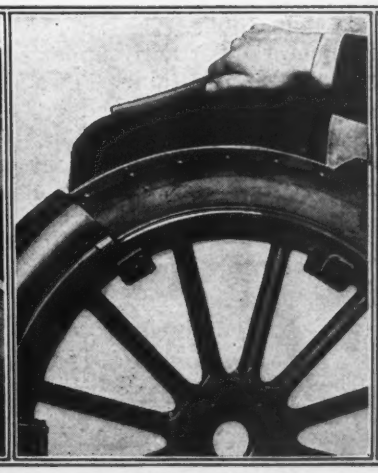
The weight of this turntable is carried on ball bearings, rolling on a circular steel track



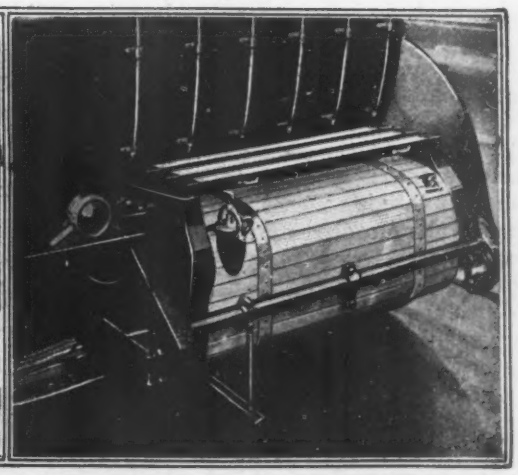
This safety signal has a red light which goes on and off constantly



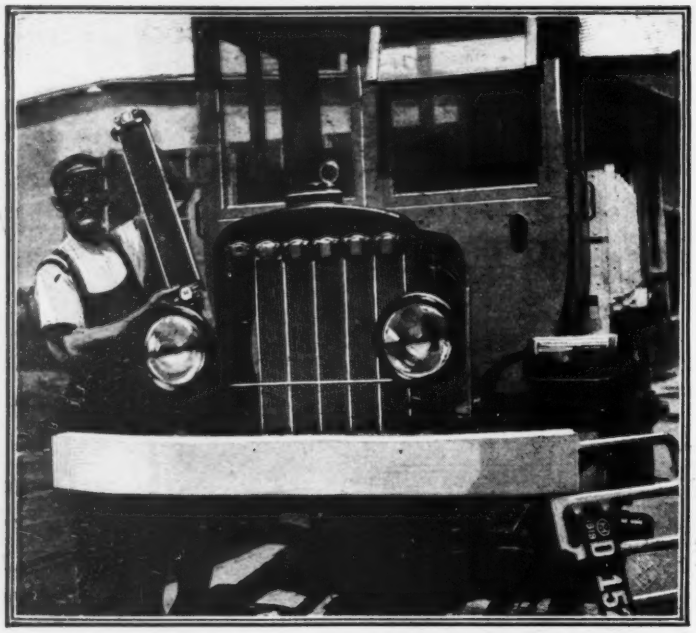
Here's a new invention that eliminates the hydrometer. If attached to your automobile it will work from the driver's seat. It also supplies distilled water to the battery



By using an additional rim, old tires are cut into sections to cover the new tire, giving it a longer life



This polished bird's-eye maple guard made of flexible boards, safeguards the gasoline tank, and minimizes the damage if your automobile is bumped by another automobile



Oil tappets in these rocker-arms prevent the upstroke of the valve from making a noise as the valves function

Eliminating Noise in Overhead Valves

OVERHEAD valves on automobile engines have recently become popular because of the greater engine-power obtainable when the valves are so placed. But, owing to the fact that the valve-rods and rocker-arms are outside of the cylinder block, engines thus equipped have been very noisy.

One method of overcoming this noise is by using an oil-cushion tappet consisting of a base that is slid down over the upper end of each valve-stem. The base supports two inverted disk vanadium steel springs which form a full elliptic spring held in place by an oil retaining cap. In action, the lower spring rests on top of the valve-stem and the rocker-arm foot on the top spring. In setting the valves, the rocker-arm is adjusted so that the tappet springs produce a positive tension on the valve mechanism from the rocker-arm itself right down to the cam.

Yet there is plenty of space between the two springs to allow for the usual expansion gap made necessary by the swelling of the parts when they have become heated after the engine has run for a short time.

Without such a part as the oil tappet, it is necessary to leave a space between the top end of the valve-stem and the rocker-arm to permit expansion due to heat, and this results in a loose valve action right down to the camshaft. It is this looseness which produces the constant tapping noises so disagreeable to the motorist and which also results in the excessive wear of the working parts.

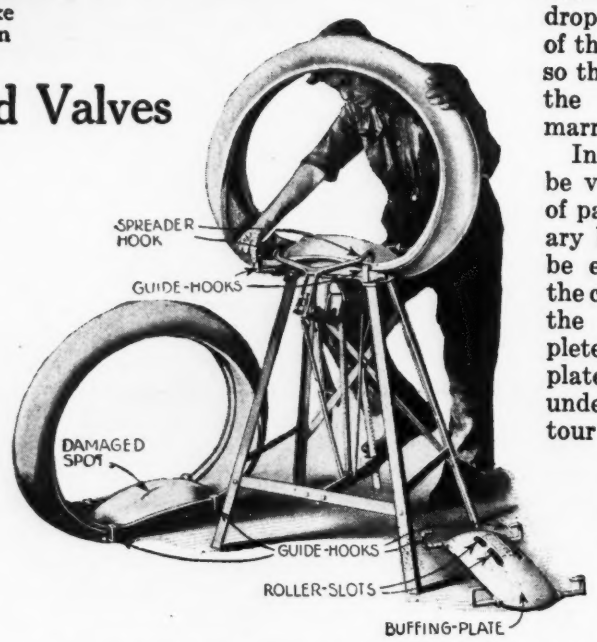
With the oil tappet, the retaining cap is filled with oil and when the motor is started, this oil is drawn in between the two springs on the upstroke of the valve so that as the rocker-arm strikes the down blow, it hits on a cushion of oil which kills the irritating noise of the valve tap.

Tire Spreader Saves Repair Time

EVERY motorist has many times taken a tire punctured on the road into the nearest garage to have it repaired, only to fret and fume when the tire man first wrestled with the rim getting it off while lying on the floor and then wasted more time trying to spread the casing with his hands to find the spot where the puncture occurred. Then, if a patch had to be put on the inside of the casing, more time was wasted trying to hold the casing apart.

A new tool for repairing tires is shown in the accompanying illustration. It consists of a stand upon which the tire is set at a height most convenient for the workman.

The tire rests upon a set of four small rollers and is held by two hooked arms which grasp the casing on both sides. These arms, which work in conjunction with the rollers, are operated by a pedal as the tire is moved around until the damaged portion is discovered. As the hooks are opened to move the tire, its weight is supported on the rollers. But when the hooks are closed to spread the casing, the rollers drop below the surface of the stand into slots so that the outside of the casing is not marred.



No need to fuss and fume to find a puncture when this tool will easily open the casing for inspection

In case the tire must be vulcanized instead of patched, an auxiliary buffing-plate may be employed to hold the casing spread until the repair is completed. The buffing-plate conforms to the under side of the contour of the casing when it is spread. The casing is thus spread at the desired spot without throwing undue strain on the fabric. The apparatus is portable.

A Dining-Table and Butler's Pantry Combined

THIS combined food-chest, butler's pantry, and dining-table may be strapped to the running-board or trunk-rack of an automobile.

When open, the flaps are supported on wire braces, forming a table. Two additional table-leaves are hooked on, supported by folding wire brackets. Two trunk-straps hold legs and front and back braces against the chest when closed, while end handles facilitate lifting. One end compartment holds tableware and cooking utensils, while the other carries the food.

Above you see the complete table and pantry in box form, to carry on the running-board; at the left the table is set, and waiting for the diners

Metal Wheels Now Used on Motor-Trucks

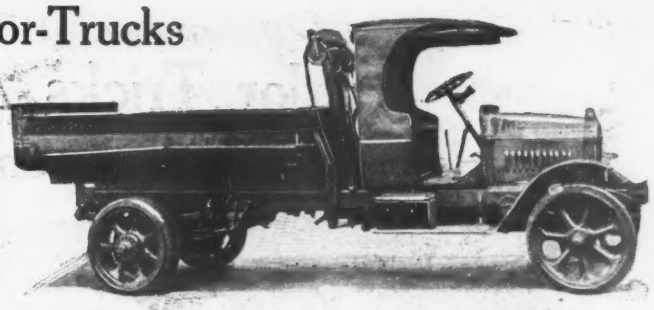
WITH the elimination of wood in many motor-truck bodies, etc., there is an increasing tendency to eliminate wood wheels and replace them with metal ones.

Those who have adopted the metal wheel point out that one disadvantage of the wood wheel for heavy trucks is the ease with which it gets out of round, due to warpage or shrinkage of the spokes after being wet, or due to a continued flatting of the solid tires.

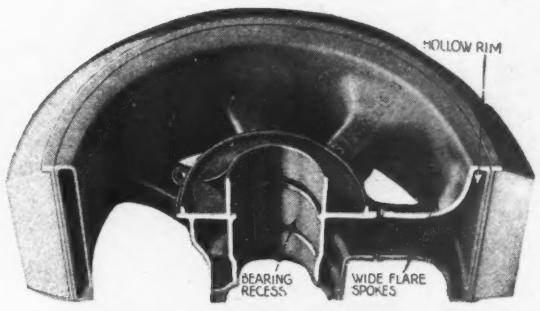
Every one knows that when the flat part of the wheel comes in contact with the rail, there is a sudden shock and a succession of sharp blows when the car gets under way. This same action takes place in the motor-truck wheel with a flat in the tire and causes rapid tire wear, due to the softness of the rubber.

Early types of steel or other metal wheels had their disadvantages, too. All drawbacks seem to have been overcome, however, in a new design of steel wheel invented by George Walther, of Dayton, Ohio. The initial cost of this wheel is more than a wood wheel, but due to its other advantages and longer life, it costs less in the end. Tested by the Bureau of Standards at Washington, D. C., the wheel was found to be lighter than wood wheels for the heavy trucks and just as light as wood wheels for light trucks. This is made possible by the hollow construction of the rim and spokes. The easy flaring curve of the spoke where it joins the rim is the most important feature of construction. This tends to prevent cracks in the spokes by distributing the road shocks over the entire wheel.

The metal wheel also radiates heat more quickly than the wood wheel and is thus more desirable.



It is safe to state that these all-metal wheels will replace the wooden ones on motor vehicles



A detail of the all-metal wheel with spokes instead of disks

Two Men Do the Work of Twenty

THE new combination excavating and loading machine shown in the accompanying illustrations does with two men the same work that would require twenty men by the old method. The apparatus is designed especially for excavating work, for the removal of materials from one location to another, and for general work where the flexibility of operation is not limited so closely as in the case of the steam-shovel. The machine is mounted on wheels, so that when the excavating work is completed at any given point, it may be easily moved to the next point.

The apparatus collects dirt at one point and then dumps or loads it into a wagon, motor-truck, or railroad-car.

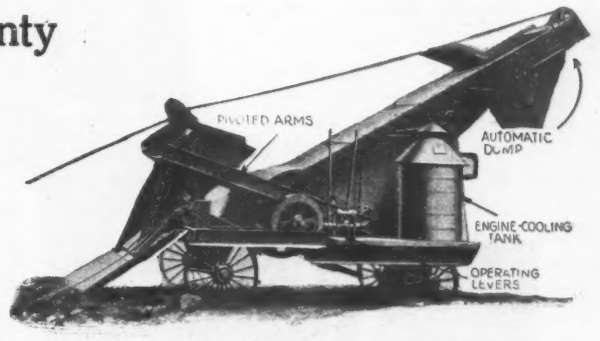
The first of the operations is performed by a skip or bucket which is pulled to and from the base of the machine on a cable wound around a drum operated by a gasoline engine mounted on the framework of the machine.

As the full or loaded skip is guided by one man holding a pair of handles to the base of the machine, the edge of the skip strikes the apron at the base of the machine and is then lifted by means of a pair of pivoted arms to the top of an incline where it is turned so that it deposits its load in a waiting vehicle below

Because the machine always stays level on the ground and draws the dirt to it, its use eliminates the necessity for building trestles required with digging devices which are placed in a hole.

One man is needed at the operating levers and one at the point of digging. As the operator at the machine places power on the digging line or cable, the other man manipulates the handles of the skip so as to fill it with the material to be dug or removed. The skip has a capacity of fifteen cubic feet of earth per trip. As soon as the skip is filled, the man releases his hold on the handles and permits the skip to be drawn to the machine. As the skip strikes the apron at the framework, it unlocks the catch of the pivoted arms, and these then carry it up over the machine and onto a slanting chute located at the front, from whence the dirt is dumped into the truck. The skip is then pulled back to the point of digging by reversing the direction of pull on the cable and the cycle of digging is ready to be repeated.

This combined excavator and loader fills the big gap between the expensive steam-shovel and the still more expensive gang of hand-shovelers.

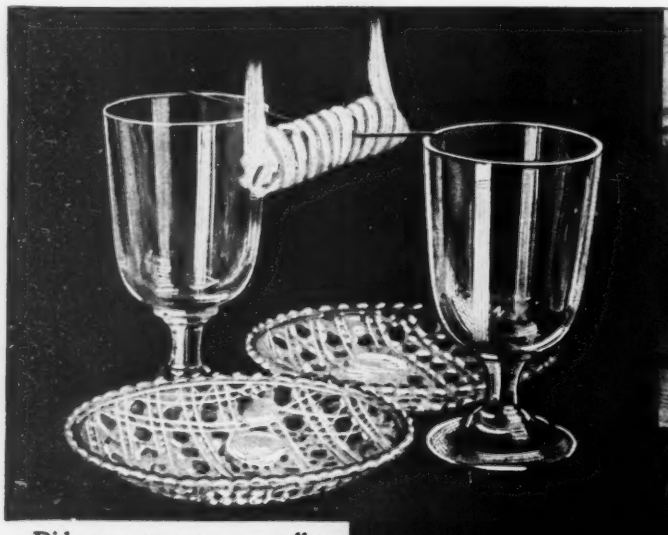


Mounted on wheels, the machine is easily moved from one excavating job to another

The combination dirt excavator and loader at work; two men can accomplish what twenty men did with older methods

Parlor Tricks Are Now in Vogue

Here are some new ones to try out on your family



Did you ever see a candle play seesaw? You run a hatpin through the center of the candle, balance the hatpin on two glasses, and then light both ends, one after the other. As the ends drip off, the candle will seesaw

Cut out some small figures. Place them on the table between two books supporting a lukewarm glass plate. Rub the glass with your hand. The tiny figures will bob up and down in a weird dance. Static electricity scores

Here is a simple trick that requires only two table-knives and a drinking-glass. The bottles are used as supports for the knives. The knives are so placed that their handles point outward. In this position, they will support the weight of the drinking-glass on their blade ends if it is put in place carefully

Take a bottle and a tube, having corks, and run a straw through holes bored in the corks. Turn the bottle and tube upside down and pour water into the tube. It will run through the straw and rise in the bottle until the level in each is the same

Prick a little hole in each end of an egg and blow out the contents. Pour in a little sand. Then the egg will stay in whatever position you place it, for the sand will always shift to the bottom as the egg is turned, apparently self-balancing

New Teeth for Old Saws

Mend your own saws and economize

By R. C. Leibe

ALL manner of saws are used in almost all wood-working plants and shops, and many breaks happen to them in the day's work. There are many good serviceable saws cast aside from lack of knowledge of how to repair them when teeth are broken out, or have bad cracks and breaks.

The writer, having spent some seventeen years in saw-fitting and machine-shop work, will explain a few of his methods of repairing saws with the aid of drawings to make the work clear to those interested.

The top sketch (Fig. 1) shows clearly just how this repair is made. We may consider the base or broken shank of saw at *B*, the foundation; which it is. The notch is filed as shown in shaded portion below. From some disused saw having teeth near the size desired, cut out a tooth far enough down to form the interlocking notch shown at *A* and file same to fit snugly and evenly the base notch below.

Make all surfaces square, otherwise patch tooth will not have a firm setting. At *C* and *D*, and around the angle halfway to *C* is where the strain comes when in use and it must fit perfectly.

At *E* is shown the under side of patched tooth, and you will note that each comes square on to the other.

Next, take a piece of silver solder, such as all sawmen use for brazing saws, and clean with a solution of muriatic and borax mixed half and half into a thin paste, or some good brazing liquid compound, and

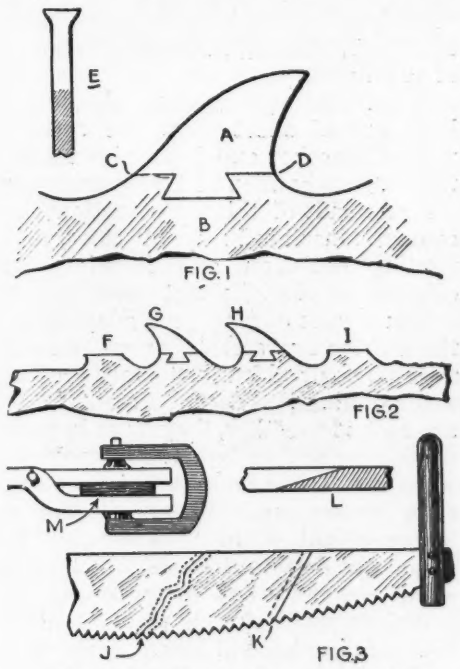


Fig. 1 shows a circular-saw repair; Fig. 2 a band-saw which was broken and remedied; and Fig. 3 a repaired break in a meat-saw

bend the thin solder strip, which is like thin paper, into a form to fit the angles of the lower notch, and press or hammer the tooth shown at *A* into its place sideways. Then see that the thin strip of solder is between the tooth and base at all parts to be joined, and press down the edges of solder protruding from the sides of saw, and you are ready to apply the red-hot irons to make the braze complete. Those who have not the regular brazing-clamps for saws, may make the joint by securing two irons, say, 3 in. wide, ¾ in. or 1 in. in thickness and about 18 in. long. Secure two hand-

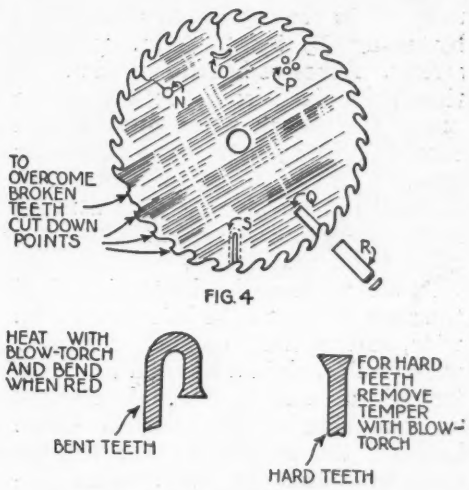
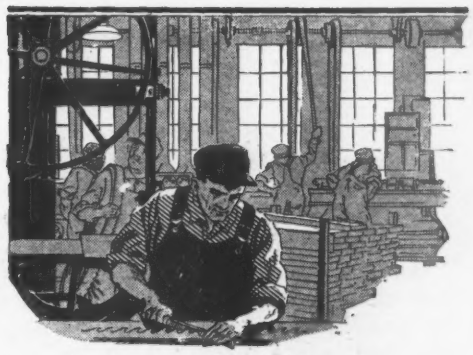


Fig. 4 illustrates different methods of fixing a cracked circular saw. The drilled hole prevents the crack from spreading

screw clamps (called belt clamps) and heat the ends of irons to a bright red (do not burn) far enough back to cover the entire patch, and apply quickly, one on each side of patch, and clamp the ends as tightly as possible over the patch. When these irons have become cool or will not boil a few drops of water thrown on them for the test, remove clamps and irons and apply a wet cloth for tempering.

After dressing it with a file, you have a tooth as strong as the remainder and one which will last until the base wears up to a point where (if it be a solid-tooth saw) it is ground down in resharpening.

The second drawing (Fig. 2) shows a section of a band-saw (narrow or wide) with four teeth broken from striking a nail in the wood, which is a common occurrence. These four broken teeth would make the saw useless as a cutter of smooth lumber, and the only remedy is to cut out the space containing them and braze the saw or fill in more teeth by some method. The writer has mended such saws satisfactorily by brazing in



After dressing the repaired saw with a file you have a tooth as strong as any of the others and one that will last for a long time

two teeth in the center of gap as shown by the same method as described with the circular-saw patching, which reduces the large gap of teeth, and the saw cuts well until the stubs at *F* and *I* come up from grinding saw to form new teeth, which take the place of the patched teeth, which also take form. When only one tooth is gone, file down the point of the back tooth to the rear a trifle and it cuts smoothly. This method applies to the two absent teeth as shown in sketch. The patched teeth are shown in *G* and *H* at shaded parts.

Many such saws are considered out of use for good. It is a simple repair to braze a cross-cut or meat-saw.

At *J* (Fig. 3) is shown the break. Note curved and dotted lines which show how the edges of the ends are trimmed with cold chisel after heating a trifle to remove the hard temper before cutting and filing laps. How it appears when ready to braze is shown at *K*, and at *L* an enlarged view of the laps and their position when ready to braze. When the laps are filed as shown, place silver solder cleaned with acid and borax between these laps and apply hot iron tongs 1 in. square to the prepared joint and clamp up tightly as shown at *M*. Such laps on a cross-cut saw should be about ½ in. wide; meat-saws, ⅜ in.

There are many methods for holding cracks in different kinds of saws.

The next sketch (Fig. 4) shows a circular saw badly cracked from overheating, badly tensioned and hammered. At *N* is shown one method of stopping a fracture, which is drilling a large hole at end of crack or slightly beyond and filling this hole with a copper rivet tightly flattened.

At *O* is the best known method of stopping a crack. It is a deep impression cut into the saw with a half-moon punch from each side of saw and joining in the center. This catches the crack, no matter how it may turn, and does not stretch the tension in saw.

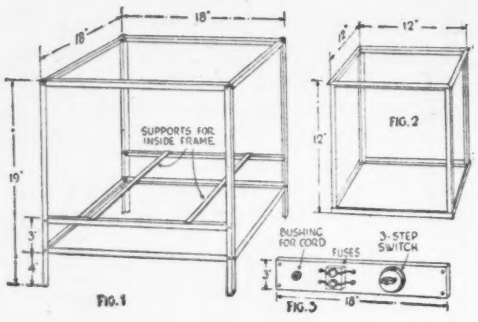
At *P* is another good method with three center punch holes. At *Q* you see how to patch a crack. Grind out a circle, and file a piece of steel to fit as shown at *R* and braze. See *S*.

How to Make an Electric Fireless Cooker

By Theron P. Foote

THE so-called fireless cooker, although fireless, necessitates some heat. In almost all fireless cookers it is applied by first heating to a definite temperature one or more iron units, which are placed above and below the receptacle containing the food. Oftentimes it is necessary to start cooking the food before placing it on the hot unit in the cooker. The principle of the fireless cooker, therefore, is its efficiency in conserving or retaining the heat first given to it. This, of course, must be accomplished by a non-conducting heat medium so that the heat cannot escape to the outside air.

In the case of the vacuum bottle, there are two glass bottles separated by a vacuum, which is one of the very best non-conductors of heat, therefore a hot liquid retains its heat for some thirty-six or more hours. But to build a fireless cooker with a vacuum around it is almost out of the question. Therefore non-conductive mediums, such as hay, straw, wool, cotton, charcoal, etc., have been used.



Figures 1 and 2 show how the frame is set up and the sheet aluminum fastened to its sides. Figure 3 is the control board

The advantages of the electric fireless cooker can readily be appreciated, as the units do not have to be removed to be heated; the food does not have to be previously cooked, and should the temperature drop because of the escape of heat, it can be immediately restored without opening the cooker or removing the food.

The construction of the cooker is comparatively simple as the inside and outside framework is made of angle-iron. Figure 1 shows in detail the construction of the outside frame while Figure 2 shows the inside frame.

Sheet galvanized iron is placed on the bottom and four sides of the outside frame (Fig. 1) and securely fastened by drilling and tapping the framework. Round-head ¼ by 8-32 in. steel machine screws were used and the sheet iron fastened to the *outside* of the framework.

For the inside framework (Fig. 2), if sheet aluminum can be secured it would be far superior to sheet galvanized iron, as the latter will rust very easily. This should be riveted to the *inside* and bottom of the inside frame.

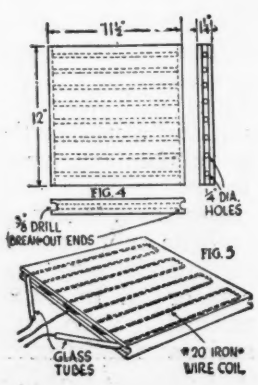
Flat-head machine screws placed in the bottom of the inside frame should extend through so as to fasten to the cross pieces located near the bottom of the outside frame, so that the top of the inside frame will be flush with the top of the outside frame.

A square piece of ¼-in. asbestos board cut to the dimensions of the top of the outside frame and having a square hole cut to dimensions of the top of the inside frame is well shellacked and dried, or preferably baked in a moderate oven until a hard glossy surface is obtained so that the asbestos will not rub off. It is then fastened to the top of the two frames by using ½ by 8-32 in. machine screws. Asbestos board is used rather than galvanized iron sheeting, as the inside framework when once heated should have as little opportunity as possible for the leakage of heat. Galvanized iron or any metal is a much faster conductor of heat than the asbestos board.

Another piece of asbestos board of the same thickness, 18 in. long by 3 in. wide, and treated in a similar manner with shellac, should be used as a control board (see Fig. 3), and mounted on one side of the *outside* frame between the supporting bar for the cross-bars and the base. The galvanized iron sheeting should be cut away from behind, as most of the wiring is done on the back of the board.

A small piece of slate 3 in. by 2 in. is securely fastened to the base angle-iron of the inside frame nearest the side for mounting the control board and fitted with three terminals. The aluminum or iron sheeting must also be cut away from the back of this board as the terminals must not touch any metal.

The heating unit is composed of a piece of soapstone 11½ in. by 12 in. by 1¼ in. thick. It must be drilled as shown in Fig. 4. Eighty-four feet of No. 20 iron resistance wire is wound as a tight spring on a 3-32-in. drill-rod and then stretched so that no two adjacent turns touch. The expanded spring is threaded through the holes in the soapstone block as in Fig. 5, the ends being left straight. The ends are then threaded through a 5-in. length of small glass tube so as to be well insulated up to the slate terminal block. A small piece of No. 18 bare copper wire is wound around the strand of iron wire at its center point and runs to the middle terminal.



Figs. 4 and 5 show the soapstone base upon which the resistance wire is wound

When the current is turned off in this fireless cooker, the food continues to cook

Two pieces of ½-in. square iron bar, about 11 in. long, should be placed on the bottom of the inside framework before putting the soapstone unit in place. This will provide an insulating wall of air, retaining the greater amount of heat which would otherwise have been lost in contact with the bottom of the container.

Asbestos wool, purchased at almost any hardware store, is then packed between the containers.

Small pieces of No. 10 asbestos-covered wire connect between the terminals on the slate and the three-heat switch mounted on the control board. This three-heat switch, when on "Low," throws current through the entire 84 ft. of resistance wire; on "Medium" through 42 ft. only; and on "High," through two parallel paths of 42 ft. each.

A suitable square cover should be bent out of sheet iron, the corners welded together and built about 3 in. thick so as to be filled with asbestos wool.

As a result of this construction the cooker is insulated from all sides, preventing radiation and insuring the efficient use of all the heat stored inside.

The classes of food best adapted to the cooker are cereals, soups, meats, vegetables, dried fruits, steamed breads, and puddings. When different foods are cooked together, they must be such as require the same amount of cooking, since the cooker can not be opened to take the food out without allowing a large amount of heat to escape. It would not do to put foods which need about one and a half hours to cook, in a cooker with, say, a piece of meat that requires several hours' cooking.

This homemade cooker has just as many advantages as the manufactured kind, and housewives will welcome its use, especially on hot summer days.

If the cooker is carefully handled, it will last a long time and give excellent service.

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RESEARCH LABORATORIES OF GENERAL ELECTRIC COMPANY

A Folding Rowboat for Touring Automobilists

By L. B. Robbins

A FOLDING and collapsible rowboat for still-water use, built of short lumber and box boards, will be found a serviceable and handy addition to any camp or sportsman's equipment. It is built of straight pieces, thus requiring no bending or curved sawing, and can be constructed by any one who can handle a hammer and saw and a yardstick. Moreover, it takes only a few moments to put together or take apart. It can be carried on the rear seat of an automobile or in a wagon, and can be tucked away in a corner of the camp when not in use. Each section forms a watertight unit in itself and renders the whole boat, when assembled, practically unsinkable.

Section *A* should be constructed first, as it is the most difficult of the three. The stem piece is of oak 8 in. long. Connect this to a transom or cross board at the rear by the two side boards. As will be seen, the ends of the transom must be cut to fit the angle at which the sides meet when spread out to its width. The sides are 8 in. wide at the front and 12 in. wide at the rear where they meet the transom, which is also 12 in. wide and 3 ft. long. The distance from the stem to the center of transom is 3 ft. Use galvanized screws for all end joints and white lead between them. Then nail on bottom boards, also painting between the joints, and saw off the ends flush with the sides. Be careful not to drive the bottom boards too close together, as water will swell them too much and possibly draw the nails. It is well to slightly bevel each board so their under edges just touch, but so that about 1-16-in. opening is between them along their outer edges. Smooth down all rough portions with a plane and then sandpaper.

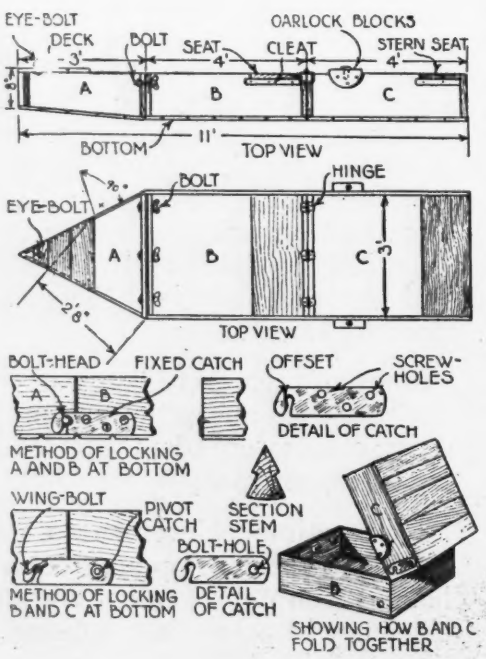
Then turn this section over on the bottom and proceed to lay on the deck as indicated. This is done exactly as the bottom boards were laid. Put in an eyebolt near the stem for something to tie the anchor line to.

Lastly, set four 4-in. bolts in the transom, 1½ in. down from the top edge and at three equidistant points as indicated. Set the heads so as to face inside the hull, with washers under them. Then give all exposed woodwork two heavy coats of paint inside and out.

Sections *B* and *C* are constructed in the same manner, but the design is even more simple, being in the shape of shallow open boxes, 4 ft. long by 3 ft. wide by 12 in. deep, inside measurement.

The seat section must be left unattached, so it merely rests upon the cleats and can be removed when being disassembled. Seat section *C* can be fixed. Place the oarlock blocks 12 in. from the front transom *C*, bolting them through the sides and raising them slightly above the top edges. Finish these and paint the same as section *A*. When dry, proceed to connect the top edges of the front transom of section *C* with the same edge of rear transom of section *B* by three heavy strap hinges. As indicated, the hinge-pin is placed at the joint of the transoms, and the legs bent over and bolted vertically. This allows the two sections to be swung together like the halves of a book. Likewise section *A* is attached to *B* by boring three holes in the forward transom of *B* to coincide with the bolts on *A*. These bolts are pushed through the holes and drawn up with wingnuts with washers underneath. Make sure that the bolts and holes coincide so that the ends of the two transoms do not offset.

After being removed from the back of the automobile, the boat is unfolded and launched. It is very light in weight



All dimensions of the folding boat are shown in the illustration. It is built of short lumber and box boards

The bottom of these two jointings are further reenforced by being held with the metal catches shown in detail. Four catches are required; two with three bolt holes and two with one large pivot hole. Make of sheet steel 10 in. long by 2 in. wide and incline the slot slightly back, ending with a somewhat larger foot. This will force the joint together as the catch is pushed in place.

The two catches with three bolt holes are bolted through the sides of section *B*, forward and close to the bottom. Be sure to have the slot down and to draw up on the bolts so as to make watertight. Arrange the two catches with bolt hole so they will be pivoted to swing free on a bolt through the sides of section *C* at the front.

Their method of engaging with a "pin" in the section adjoining is clearly shown in the two detail illustrations. The "pins" are bolts, fitting the slots in the catches, which are put through the sides of sections so the heads are inside. The pivoted catch is secured to its pin by setting down on a wingnut, while the fixed catch simply slips under the bolthead before the transom bolts are tightened up.

With all bolts tightened up and catches in place the three sections make a rigid hull capable of carrying two men in still water.

To disassemble: Take off section *A* entirely by unhooking the catches and taking off wing-nuts, then pulling off bodily. Place it inside section *B*, first removing seat. By setting side *C* against the side of *B* the opposite angle will be 2 ft. 8 in., and will allow the section to nest inside its 3-ft. width. Then release the catches holding *B* to *C* and fold *C* over on to *B*. This encloses the entire boat, 11 ft. long by 3 ft. wide, in a space 4 ft by 2 ft. by 3 ft.

Make transoms of fairly heavy hard wood to stand the strain due to being fastened together. If box boards enter into the construction, see that all nail and worm holes are plugged with soft-wood plugs before painting. With care in selecting, this boat can be entirely built of box lumber and the cost greatly reduced.

The boat should be painted with three coats of good paint, and to avoid the difficulty of reaching the extreme parts of the bow and stern after the seats are on, paint these places as the work progresses, not forgetting to paint the bottom. A single coat of thick paint will suffice for this. The outside may be finished "bright" if desired, in which case give it three or four coats of a good spar varnish.

After the paint has thoroughly dried, try the boat out in a river or pond. Calk all leaks and go over it carefully.

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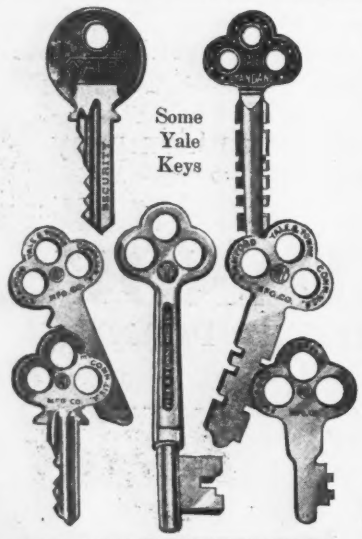

Some Yale Keys

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TRADE MARK

How to Use and Care for Milling Cutters

By E. S. Goodell

OPERATIONS can be performed and metal machined and shaped on the milling machine so quickly and accurately that the machine is a valuable member of the machine-shop.

In some cases we must depend upon the miller altogether as that is the only machine that will perform the work. The miller is also used extensively in the making of parts of machines. With the aid of jigs pieces are set and held secure on the milling machine table and milled accurately so they are ready for the assembling department with very little fitting.

Milling-machine cutting is a science all by itself. The suggestions in this article will help you to get better results from your work

Results can be obtained only by good treatment and care of the milling cutters, as they are not made to stand rough handling and are expensive tools.

Overspeeding will ruin a cutter quicker than heavy feeding, as a heavier cut can be taken at a slow speed than at a high one.

For removing stock take a roughing cut with a coarse tooth-mill, having only two or three teeth in the bearing at one time. Experience has shown that a coarse tooth-mill takes less power than one with fine teeth, as the latter has more points in contact.

Finishing cuts should be done with a fine tooth-mill and light cut, thus having a small amount of metal to take off; the space between the teeth taking care of the free material.

There is more chance for the escape of chips in the roughing cut by the use of a coarse-tooth cutter.

Where wavy lines show on the finished surface it is usually caused by cutters not running true, the work springing, or the arbor being too light. Use as small a cutter as possible, where it will permit, as they cost less and do not require as much power to operate.

When putting the cutter on, see that the arbor is clean and free from chips, as any particle of metal would throw the mill out of true.

The cutter should be kept sharp. When sharpening cutters, use care. Giving 7 degrees clearance for roughing and 5 degrees clearance for finishing is a good rule. Where it is too sharp an angle, it will wear away the point of the teeth and the cutting edge will not have enough support.

The cutters are ground true; but in tempering, some of the teeth will not be as hard as others, the softer teeth wearing away by use before the others, thus making an uneven running mill.

When milling steel, use a good supply of oil, and the cutter will stay sharp longer and do better work.

Properly ground cutters, running true, and all their cutting edges doing their share of work, last longer, work better, and will stand a heavy feed. It takes more power to drive a dull cutter, doing poor work, besides wearing the cutter out faster. The friction which a dull cutter makes is transformed into heat. The cutting edges will be softened by this and are soon used up. The life of the cutter is shortened more by this than if it were sharpened many times.

Put on writing-paper washers between the steel washers and the cutter to keep it from slipping on its arbor. Thin brass or copper washers may also be used.

The nature of the material to be milled should govern the speed. A general rule used is that the harder the material the slower the cutting. A higher speed can be used while the cutter remains sharp and where the heat generated in the cutting operation is carried away by oil or soda-water.

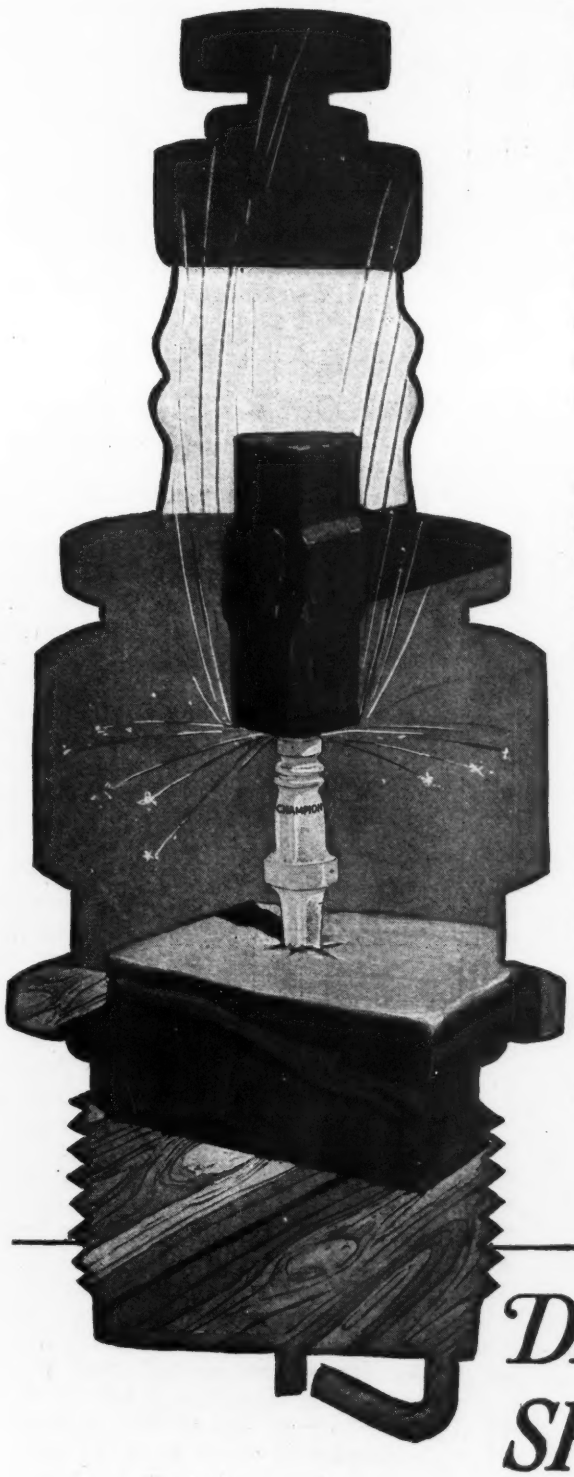
The character of the work will govern somewhat the rate of feed. If it will spring easily, a fine feed must be employed, but a coarse feed can be used where the work is very rigid.

Cutters with helical cutting edges are better for wide surfaces than straight-tooth ones, as the helical-tooth cutters shave the metal at an angle, beginning at one edge and gradually proceeding over the surface to the other edge. It does not require as much power for these cutters as straight ones, and they also make a better finished surface.

Feed the work toward the cutter slowly when starting a trial cut, as this will prevent the tool from digging in the work and breaking teeth or loosening the piece to be machined from its fastenings on the table. This might also have a tendency to spring the cutter arbor out of true. The cutter should be removed from the arbor when the milling is finished, cleaned and put in the wall cabinet or drawer where the cutters are kept.

If the foregoing suggestions are carefully followed, the milling cutters will be found to have improved one hundred per cent.

Champion



You Have Never Tried This of Course

BUT if you will give a Champion No. 3450 Insulator this test you will find that the Insulator can be successfully driven into a solid bar of lead without cracking or injuring the Insulator in the slightest.

Our No. 3450 Insulator, the foundation of all genuine Champion Spark Plugs, has been perfected until it will stand up under abnormal conditions—conditions far more severe than those encountered in ordinary usage.

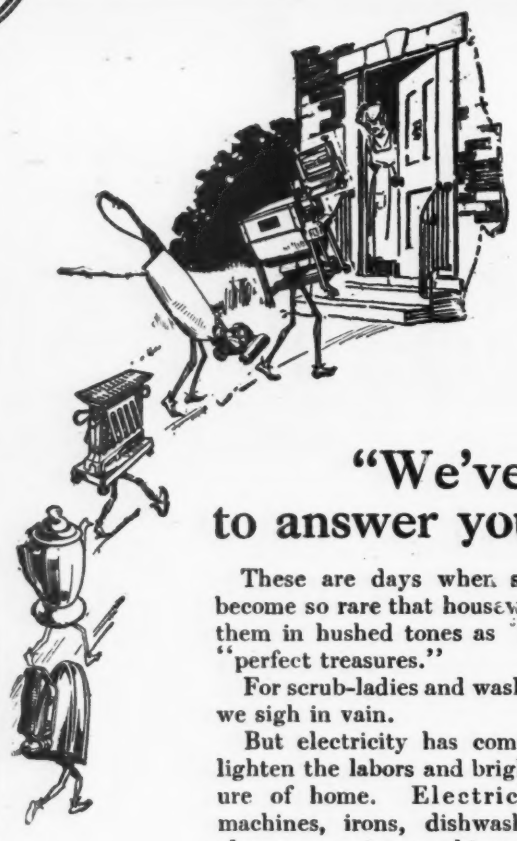
Champion dependability accounts for the fact that Champion Spark Plugs have been adopted as standard equipment by more automobile, truck, tractor and engine manufacturers than any other make of spark plug.

Be sure the name Champion is on the Insulator and the World Trade Mark on the Box

Champion Spark Plug Company
To!edo, Ohio

Champion Spark Plug Company of Canada, Limited, Windsor, Ontario

DEPENDABLE SPARK PLUGS



"We've come to answer your ad"

These are days when servants have become so rare that housewives speak of them in hushed tones as "jewels" and "perfect treasures."

For scrub-ladies and wash ladies, alas! we sigh in vain.

But electricity has come in time to lighten the labors and brighten the leisure of home. Electrical washing machines, irons, dishwashers, vacuum cleaners, sewing machines—all ready to put in a twenty-four hour day. Whether our house is old or new, we can have it wired for these modern conveniences.

But it's a natural question to ask, "How can the electrician get all those wires through the walls without putting us out of house and home while he's doing it?"

Just watch him dexterously pass a wire down behind the wall and "fish" it out on the floor below. Or see with what ease he wires a fixture by taking up a board in the flooring above and reaching down.

Mindful of the householder's care for his furnishings, the electrical contractor works in neat and orderly fashion, protecting woodwork, furniture and plaster as he goes, without interruption to the use of the rooms.

So while he is at it, let the contractor work out his plans for ample circuits. Indeed, the more fixtures and sockets and baseboard outlets, the more opportunities does he give electricity to prove itself the all-around aid we have been longing for.

In plan and installation the contractor's experience is a sure guide to that "Well, we're glad we had the electricity put in" feeling.

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

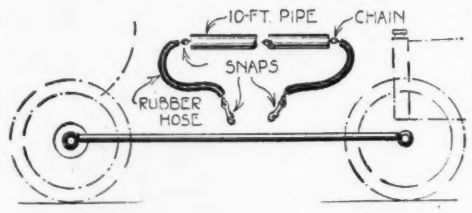
Western Electric Company

No. 14. *Don't think only of Western Electric as a name on your vacuum cleaner or iron, but also as an organization which serves in street lighting, in safe and rapid travel, in communication by wire or wireless—and in every other field of electrical achievement.*

A Staple Towing Device for an Automobile

IN case of accident while driving in the country, the homemade towing device illustrated will prove very convenient in keeping the towed car from running into the one in front, especially if the brakes have been put out of commission, which is very often the case.

The device consists of a 1-in. pipe, 10 ft. long, and a 14-ft. chain small enough to go through the pipe. Put



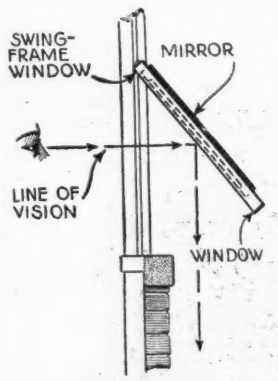
When towing an automobile the rope often breaks. Here is a device to pull you home

two heavy snaps on the ends of the chain and cover the sections between the pipe and the ends with old pieces of rubber hose to prevent marring the car when it is attached.

Watch Out for That Telltale Little Periscope

THE next time you stand on the steps to say goodnight to your beloved by the light of the moon, beware lest her watchful and up-to-date parent be observing the proceedings from the room above, by means of the periscope adaptation shown in the cut.

This is no more than a large mirror placed on a swing-frame window which is adjusted to an angle of forty-five degrees to the ground. It may be attached to a French window or blind when it is desired to look from a side room on to the porch. The images in the mirror will be clearly visible from any corner of the room.



Using a periscope is an amusing pastime, though savoring somewhat of war

The mirror periscope can be put to a great variety of uses. With it the invalid may lie in bed and watch goings-on in the street below. The housewife may size up her caller and decide whether or not to be "at home"; and the young doctor can tell whether it is a bill collector, or a prospective patient ringing the doorbell, and thus be prepared to mold his manner to meet them.—P. L. FETHERSTON.

U. S. Bicycle Tires are getting a larger following among *straight-thinking* bicycle riders all the time.

And whenever anyone starts using U. S. Bicycle Tires, he *sticks to them.*

U. S. Chain Treads, U. S. Cords and seven other treads in Clincher and Single tube styles.

"Ride a Bicycle"

United States Tires

United States (US) Rubber Company

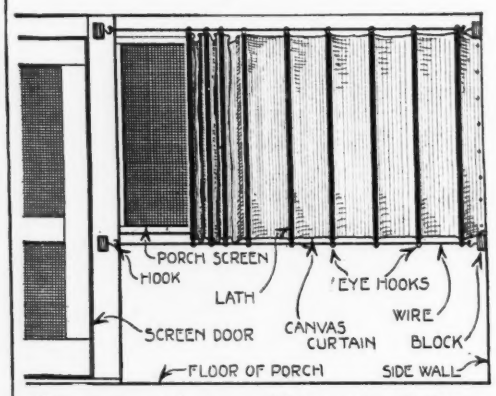
The Best of News!
The Upholstery of Quality
CHASE
Leatherwove
CHASE
Leatherwove
THE UPHOLSTERY OF QUALITY
MADE BY SANFORD MILLS, SANFORD, MAINE
'Tis good news to hear that Chase Leatherwove has been proclaimed "best for upholstery purposes."
For Furniture, Motor Car, Boat and Carriage Upholstery
Re-upholster with Chase Leatherwove. Write for Samples.
L. C. CHASE & CO. BOSTON
New York Detroit San Francisco Chicago

Canvas Curtains for the Sleeping-Porch

THE ordinary screened porch may be made into a snug, all-weather sleeping-porch by adding canvas curtains to the open side as shown in the illustration. This has been done in a number of instances, but since the method of attaching the curtains in this instance seems to be somewhat novel and is extremely simple and effective, the description of their construction is given below.

As is shown, the curtain is tacked to light wood strips, each end of which is provided with a screw-eye and held in place by two taut wires running through them, evenly spaced, and extending across the screened portion of the porch front. Thus the opening may be closed by stretching it out and opened by unhooking the curtain and sliding it to one side. The cut shows the curtain partly closed.

Small blocks of wood are screwed at each corner of the screened opening,



If canvas curtains are added to the sleeping-porch you can use it both summer and winter

the upper blocks being about three inches above the top of the screen and the lower ones the same distance below. Two wires are cut 1 ft. longer than the length of opening and one end of each twisted about a screw hook. These are then turned into the blocks at one end. For the wood strips, even-grained lath are procured and ripped into two pieces and smoothed off with sandpaper. These are then spaced 1 ft. apart along the curtain, which is slightly wider than the opening, and the curtain tacked to them. Small screw-eyes are screwed into the top and bottom of each strip and the two wires run through them.

Two other hooks are then made fast to the loose ends of the wires and screwed into the blocks as shown. To prevent too great a twisting effect in the wires which might eventually work the screws out, the wire, before the last two screws are screwed in, is twisted in the opposite direction as far as possible. Thus when the wires are in place and taut, the only strain is with the length of the wires. These should be quite tight to prevent undue sagging of the curtain and should fit tightly to the casing of the opening.

One end of the curtain is provided with a hook so that it may be drawn

out and fastened and the other end is made fast. This may be done by nailing or tacking.

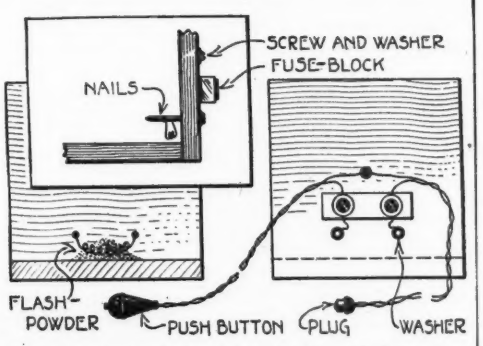
The man who uses this curtain has found that it makes the porch good sleeping quarters for practically the whole year, as it prevents any storm from entering. Once such outdoor quarters are used, the colder nights of fall and early winter hold no terrors and they are, relatively, cheap insurance against the multitude of minor ills which are wont to throw us mortals out of complete trim.

Interior Photography for the Amateur

THE amateur photographer who does not have a very fast lens often encounters trouble in taking interior photographs, particularly of a living subject, such as a baby or animal.

In most cases the flashlight powder or paper is resorted to as a means of sufficient light so that the time for exposure is shortened as much as possible. But in many cases, failure has resulted. It is easy to be seen, therefore, that some method must be adopted whereby the powder itself is ignited at the moment desired.

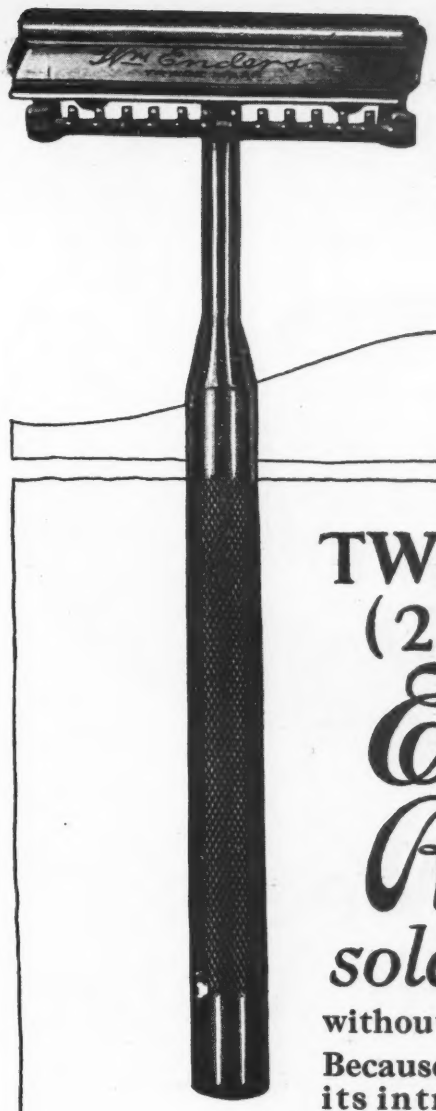
To accomplish this result I have taken two pieces of pine wood, approximately 12 in. square, and nailed them together at right angles. (See the accompanying illustration.) From



Here is the front and back view of the powder-igniting apparatus ready for instant use

the back of the upright piece I have driven two nails, each having two small washers on, the ends of the nails to protrude above the bottom board about 1 in. and being approximately 2 in. apart. Placing a small piece of copper wire between the washers drives the nails in hard.

Mount an Edison base fuse-block on the back of the upright board and just above the heads of the nails so that the copper wires from these nails may be attached to one side of the fuse-block. A small round-head wood screw, also having two small copper washers, is placed in the upright and just above the fuse-block. A 10- or 12-ft. extension cord, having on one end an Edison base-plug which will fit any standard electric-light socket, is obtained, and the two wires of the other end are fastened, one under the washer of the wood screw and the other to one of the top contact screws on the fuse-block. On one end of



TWO MILLION
(2,000,000)
Enders
SAFETY
Razors
sold—

without advertising—

Because this is the first time, since its introduction, 13 years ago, that the Enders production has been able to catch up with the demand—a demand created wholly by its enthusiastic users.

It has made good, invariably, and continuously, on merit alone, without a word of urge or argument from its makers.

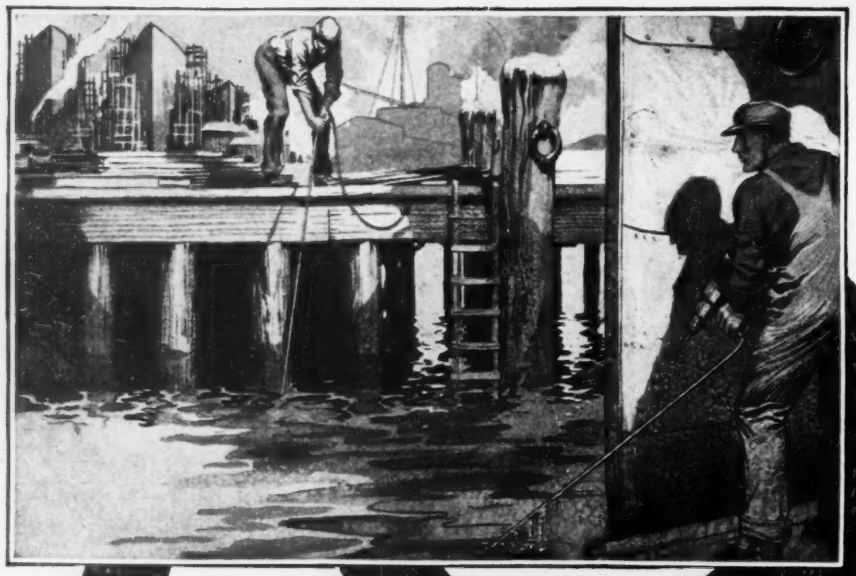
And, since Enders has sold so well on personal recommendation alone, I want to continue that method, even in advertising, and, as "the man who made it," ask the readers of the Popular Science Monthly just to *try it*.

ENDERS SELLS FOR $1.00—with six blades of the finest quality Swedish-base steel. Packed in a small convenient plush-lined box.

BEST DEALERS EVERYWHERE SELL IT.

Wm Enders

ENDERS SALES COMPANY
17 BATTERY PLACE
NEW YORK



Five Weeks of Salt Water!

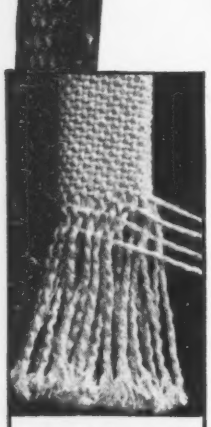
Down at a big Baltimore shipyard a piece of portable electric cord became wedged in a piling under the salt water. It could not be pulled out but they kept on using the tool with the cord submerged.

The cord was Duracord. And after five weeks of salt water it was still going strong!

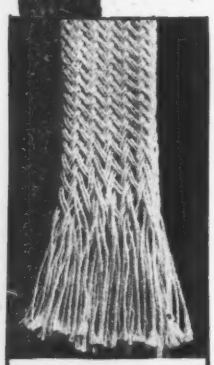
DURACORD
TRADE-MARK

has a thick, heavy covering *woven* like a piece of fire hose, that withstands oil, gasoline and hard usage just as it shed salt water. It increases efficiency and keeps down costs. It will add to the value of any electrical tool, machine or hand lamp equipped with it.

Duracord can be furnished in all sizes of portable electric cord and also in the larger sizes of single and duplex cable. Ask your electrical jobber about Duracord or let us send you samples of Duracord and ordinary cord for you to test and compare yourself.



This is Duracord. Thick, heavy strands, woven like a piece of fire hose, not braided. Picture shows outside covering only with impregnating compound removed.



Here is the ordinary braided cable covering. Note the open and porous construction, easily cut, stretched or unraveled. Compare it with the illustration of Duracord above.

TUBULAR WOVEN FABRIC CO.
Pawtucket, R. I.
Makers of Duraduct
Flexible Non-Metallic Conduit
and tubular woven fabrics of all kinds

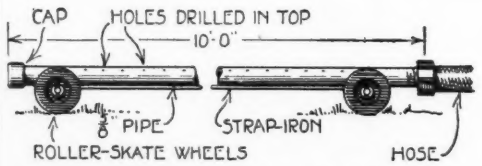
another 10- or 12-ft. extension cord mount a pear push-button and at the opposite end of the cord, connect one wire under the washers of the wood screw, and the other to the remaining contact screw on the fuse-block. About 20-amp. fuses should be placed in the fuse-block, the amperage of the fuses, however, depending upon the size of iron resistance wire to be used.

Placing the apparatus in position, a trifle at the back of the camera and to one side, connect the plug to the electric-light socket. Between the two nails on the front of the board wind a very small, fine, hairlike piece of iron wire, being generous enough with the length so that part of the wire will fall and run through the flashlight powder, which is placed on the front side of the boards directly under the two nails.

Open the shutter of the camera and a slight pressure on the push-button ignites the powder almost instantly. Exactly how quick after the contact is made the powder ignites depends entirely upon the size of iron resistance wire, as the finer the wire the quicker it heats and ignites the powder.—THERON P. FOOTE.

A Lawn-Sprinkler of Large Capacity

WHEN there is a large lawn to be kept watered through the hot dry summer, it is quite a job to cover the whole lawn with a small circular sprinkler. If there are no children about the house to attend to it, the job usually waits until the men have spare time at night, and often then, if the lawn is very large, there is not time to get over the whole of it and give it enough water at the same time. The illustration shows how one man solved the problem.



This sprinkler truck can be pulled about the lawn while watering the grass without having to turn off the water every time to move it

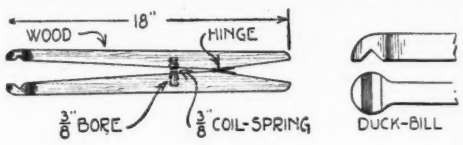
A 10-ft. length of pipe ⅝ in. in diameter was procured and two rows of 1/16-in. holes bored in the top ½ in. apart, so that when the water was turned on, the streams of water coming through them fell evenly over the ground.

The truck upon which the sprinkler was mounted was made from an old roller-skate. The rollers were taken off with the axles and each connected to a 6-ft. length of strap iron. The pipe was laid between the rollers and fastened with wire.

For use the pipe was plugged at one end with a wood plug, and the other was fitted to the hose.—D. VAN HORN.

Tongs for Removing Clothes from Hot Water

THE tongs shown in the accompanying illustration will be found handy for removing clothes from the steaming hot water in the boiler. The clothes can be firmly grasped and lifted out without allowing them to slip back and splash the hot water over the



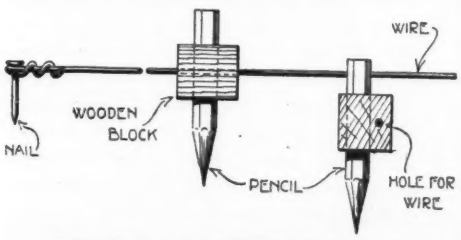
Make a pair of clothes-tongs for your wife to prevent her hands from chapping

user's hands. This being a pet trick of the ordinary broom-handle variety of "clothes stick."

The tongs are made of wood about 18 in. long and shaped as shown. Each leg is about ½ in. thick along its entire length, except at the working end. The tongs should broaden out here into a duckbill shape. This is to provide a grip of wide contact, thereby preventing damage to the clothing. A hinge is used for the fulcrum and is fastened with screws. The shape of this hinge can be noted from the illustration. A hole is bored in each leg in approximately the position shown in the sketch. A 1-in. hinge is cut so that the leaves can be turned up and holes drilled and countersunk for screws as shown. Fit a stiff spring, not over ⅜ in. in diameter, into the hole previously bored. This, of course, must be done before the hinge is screwed into place.

An Improvised Compass for Large Work

WHEN there is sudden need for a compass for scribing large circles, don't depend upon a pencil and a piece of string. It is not at all accurate. Take a piece of wire—telegraph wire, for instance—as long as may be necessary, and get it fairly straight. Loop and twist one end around a wire nail, or anything with a point. If a wire nail is used, file off the angles of the point so it will not drill into the wood when the compass is turned. Drill a small



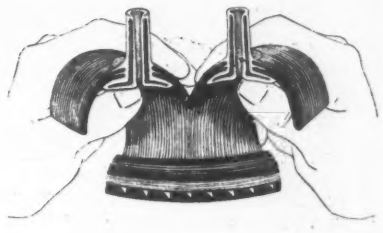
Why buy a manufactured compass when this one will do good work?

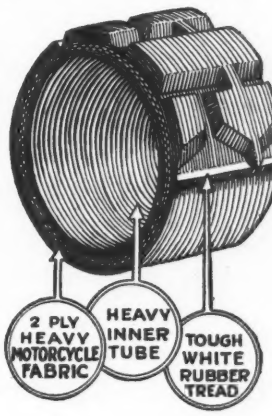
block of wood with a hole in which the pencil will fit tightly. At right angles, and to one side of the pencil hole, drill a hole that will be a tight fit for the wire, but will permit the block to slide with a little persuasion, and the job is finished.

Ride a Bicycle

Bicycle Tire Facts

Kokomos Everlaster Bicycle Tires render unusual service. They do not puncture easily and are not subject to troublesome leaks around the valve stems.





Because of Better Construction

Everlaster Tires have an extra thick, inside, pure rubber section or inner tube. This is supported by two thicknesses of tremendously strong motorcycle fabric—not the much lighter fabric ordinarily used in bicycle tires. The tread is of heavy white rubber—"twin grip design"—easy running because the weight is pivoted on the continuous center rib, non-skid because of the broad, sharp-angled studs on both sides.

Note Valve Anchorage

The dovetail construction makes it proof against loosening and gives three-way protection against air leakage. Such a valve costs more to make, but the Everlaster is built to service, and not price, standards. Buy Kokomos next, for when you get Kokomos on your wheel, you've got something.

Sent Free: "The Bike Book"

Here's a valuable book to remember Kokomo by; tells how to take care of tires so as to get maximum service; gives, also, a lot of common sense hints on bicycle riding, etc. Sent anywhere, on request.

KOKOMO RUBBER COMPANY
KOKOMO, INDIANA

LONG-LIFE
KOKOMO
BICYCLE TIRES

HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This Course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

YOU RUN NO RISK So that you may see for yourself how thorough and complete our training is, we invite you to take *ten lessons* in the High School Course—or any course of specialized training in the coupon below—before deciding whether you wish to continue. If you are not then satisfied, we will refund your money in full. *We absolutely guarantee satisfaction.* On that basis you owe it to yourself to make the test.

Check and mail the coupon NOW for full particulars and Free Bulletin.

AMERICAN SCHOOL OF CORRESPONDENCE
Dept. H 675 Chicago, Illinois

TRAINING—THE KEY TO SUCCESS — ASC

Explain how I can qualify for the position checked.

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...Electrical Engineer	...Business Manager
...Elec. Light & Power Supt.	...Certified Pub. Accountant
...Hydroelectric Engineer	...Accountant and Auditor
...Telephone Engineer	...Bookkeeper
...Telegraph Engineer	...Stenographer
...Wireless Operator	...Fire Insurance Expert
...Architect	...Sanitary Engineer
...Building Contractor	...Master Plumber
...Civil Engineer	...Heating & Vent. Engineer
...Structural Engineer	...Automobile Engineer
...Mechanical Engineer	...Automobile Repairman
...Shop Superintendent	...Airplane Mechanic
...Steam Engineer	...General Education Course
...Draftsman and Designer	...Common School Branches
...Photoplay Writer	...Foreman's Training Course
...Employment Manager	

Name .....

Address .....

Have You a Step-Saving House?

The Popular Science Monthly will pay ninety dollars for the best answers

HOW do you save steps in your home? What arrangements or what appliances have you made that save time and reduce work that would otherwise have to be done by hand?

The Popular Science Monthly wants to know just what practical and useful things can be constructed to make every house a step-saving home. For instance: a concealed laundry chute would interest us, if it weren't so old; a space-saving cupboard—another old one. No patented or marketed appliances will be considered.

The Popular Science Monthly offers three cash prizes—a first prize of $50, a second prize of $25, and a third prize of $15—to be awarded in accordance with the rules set forth below.

Rules Governing the Contest

(1) Contestants are not limited to the number of step-savers and time-savers, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method must be shown clearly either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on heavy white paper. The views should be sufficient in number to set forth the writer's idea very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the Popular Science Monthly not later than 5 p. m. on Friday, December 31, 1920.

(5) The judges of the contest will be the editors of the Popular Science Monthly.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best method for saving steps in the house.

The second prize of $25 will be paid to the contestant who submits a method next in merit.

The third prize of $15 will be paid to the contestant who submits the method third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of the Popular Science Monthly. A description of the methods which win the three prizes offered will duly appear in the pages of the Popular Science Monthly, together with the names of the winners.

(8) The editors of the Popular Science Monthly shall have the right to publish meritorious manuscripts which do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) When a contestant submits more than one method, the description and drawing by which each is set forth must be sent as a separate unit.

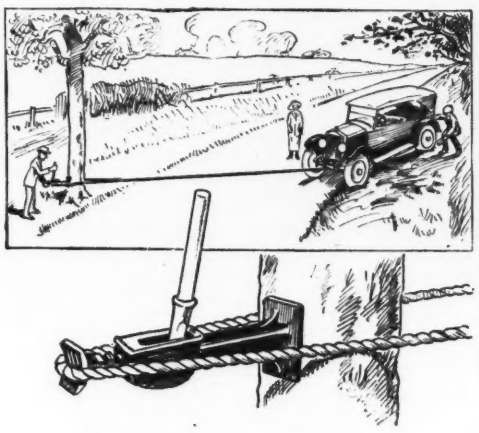
(10) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(11) Send drawings and specifications to the Editor of the Step-Saving House, Popular Science Monthly, 225 West 39th Street, New York City.

Pull the Car Out of the Mud with a Jack

SOMETIMES the automobilist accidentally gets his car in such a position in a mud-hole, over a bank, or in a similar predicament, that the power of the car has no effect in helping itself out. In that case, where the car is not too firmly imbedded or stalled, the wheel-jack can be brought to the rescue. A tree or post and some rope are also required.

Lash the rope to the necessary axle and loop it loosely about the tree or post. Then carry it back to the car and lash the remaining end to the same axle.



With the jack pulling against the rope, the car is very easily hauled out of the mud

Now take the jack and shorten it up as much as possible and set it between the tree and the ropes, away from the car.

If too much slack occurs, take it up by retying one end of the rope on the axle.

When in the proper position, extend the jack as far as it will go. If this has caused the car to move, block the wheels. If not, compress the jack again and take up any resulting slack in the rope.

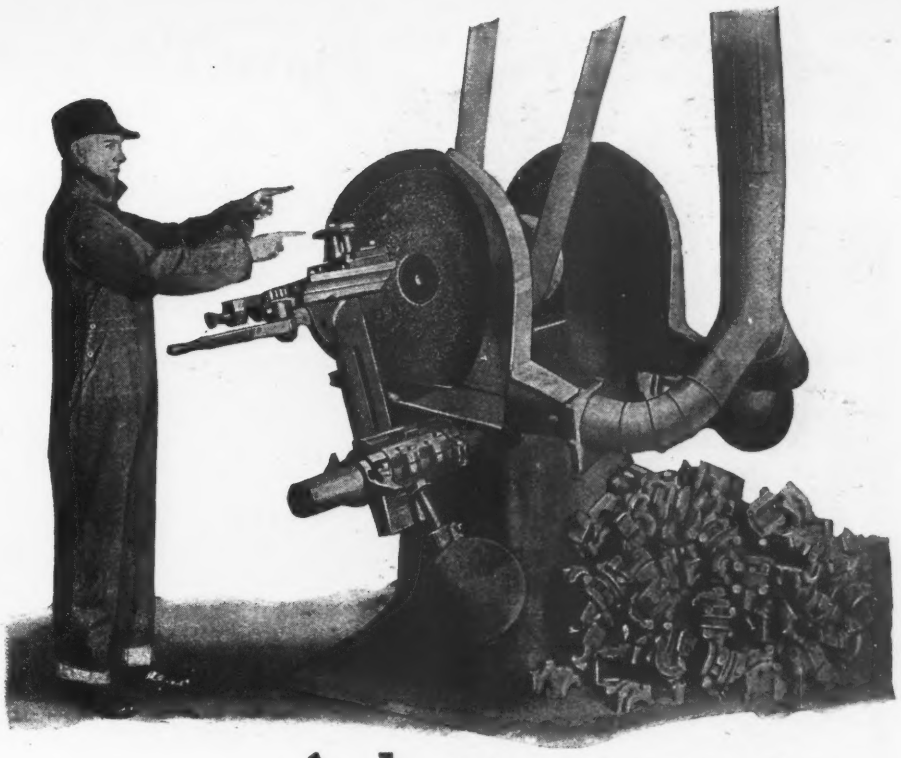
Repeat this operation as frequently as necessary, blocking the car each time so it will not return to its old position. In time it can be pulled out to the road again.

Place jack as low down on tree as possible so leverage of pulling will not tend to pull the tree itself.

Prolonging the Life of Inner Tubes

MANY automobilists allow their rims to become badly rusted. The rough particles of rust and scale act like sandpaper on the inner tube, and a prematurely worn tube or blow-out is the result. An occasional coat of aluminum paint when the tires are removed will act as a rust preventive and greatly prolong the life of the tubes.

When changing a tire, don't forget to sift French chalk in the tire. This prevents the tube from chafing.



A better way to finish small castings

The man in the picture clamps a casting in the swinging arbor, pushes it against the high speed disc—once, twice!—and the casting is finished to a true surface—ready for the assembling room.

This is an example of the quick work done at low cost by tough discs of U. S. Metal Abrasives cemented to metal wheels. The wheels may be vertical, as illustrated—or horizontal for heavier work, so that the weight of the casting holds it down against the speeding disc.

Every foundry and machine shop will find quick profits in using Herculundum Discs for cast iron and similar materials, and Carbalox for steel, brass, copper, aluminum, etc. Both are products of the electric furnace and may be had also in sheets, belts and rolls of convenient widths. Both may be identified by the U. S. map trade-mark, found also on fine grades of emery paper, flint and garnet papers and cloth.

You cannot sharpen abrasives, therefore buy the best from U. S. Our Service Department will study your requirements, and recommend the grades best suited to your work. Tell us whether you work on wood, metal, leather or composition materials.

United States SAND PAPER

Fast-Cutting Mineral Abrasives
On cloth and paper
Flint Paper
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Sheets, Discs, Circles, Belts and Rolls of various widths and lengths of the above U. S. Abrasives.

UNITED STATES SAND PAPER COMPANY
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For You, Also

Teeth that glisten—safer teeth

All statements approved by high dental authorities

You see glistening teeth wherever you look today. Perhaps you wonder how the owners get them.

Ask and they will tell you. Millions are now using a new method of teeth cleaning. This is to urge you to try it — without cost — and see what it does for your teeth.

Why teeth discolor

Your teeth are coated by a viscous film. You can feel it with your tongue. It dims the teeth, and modern science traces most tooth troubles to it.

Film clings to teeth, enters crevices and stays. The ordinary tooth paste does not dissolve it, so the tooth brush fails to end it. As a result, few people have escaped tooth troubles, despite the daily brushing.

It is the film-coat that discolors—not the teeth. Film is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar are the chief cause of pyorrhea. So all these troubles have been constantly increasing.

Now they remove it

Dental science, after years of searching, has found a film combatant. Able authorities have amply proved its efficiency. Millions of people have watched its results.

The method is embodied in a dentifrice called Pepsodent. And this tooth paste is made to in every way meet modern dental requirements.

Active pepsin now applied

The film is albuminous matter. So Pepsodent is based on pepsin, the digestant of albumin. The object is to dissolve the film, then to day by day combat it.

This method long seemed impossible. Pepsin must be activated, and the usual agent is an acid harmful to the teeth. But science has found a harmless activating method. Now active pepsin can be daily applied, and forced wherever the film goes.

Two other new-day methods are combined with this. Thus Pepsodent in three ways shows unique efficiency.

Watch the results for yourself. Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how the teeth whiten as the film-coat disappears.

This test will be a revelation. It will bring to you and yours, we think, a new teeth cleaning era. Cut out the coupon so you won't forget.

Pepsodent PAT OFF. REG. U.S.

The New-Day Dentifrice

A scientific film combatant combined with two other modern requisites. Now advised by leading dentists everywhere and supplied by all druggists in large tubes.

10-Day Tube Free 391

THE PEPSODENT COMPANY,
Dept. 750, 1104 S. Wabash Ave.,
Chicago, Ill.

Mail 10-Day Tube of Pepsodent to

.....

.....

Only one tube to a family

A Safe Method of Kindling a Fire with Kerosene

THE usual custom of throwing on a little kerosene when a fire will not ignite readily is always accompanied with danger; especially if there are any live coals left in the grate. This danger of a flare-back and possible injury by burning can be overcome in the following way and is as novel as it is simple.

Ashes soaked with kerosene will permit the fire to be ignited without danger

Take a large metal vessel, such as an old bucket or large tin can, and fill it with wood ashes nearly to the top. Then pour in enough kerosene to thoroughly saturate the ashes without making them sloppy. Let stand a few hours, covered, so as to impregnate the mass thoroughly.

When ready to light the fire, lay a few large spoonfuls upon the kindlings and touch with a lighted match. It will take fire and burn with a steady flame for considerable time without a suggestion of flaring. Laid upon live coals it will burn in the same manner and consequently it eliminates all danger.—WINDSOR CROWELL.

To Make an Anti-Rattler for Tire Chains

DO you lock your spare tires on? If you do, and use the ordinary chain and padlock, you undoubtedly are disturbed by the rattling of the chain.

You have also noticed how it bruises the paint on the parts with which it comes in contact. Perhaps you adopted the common expedient of covering the chain with a piece of hose, and perhaps you have also found the hose so stiff that it is still noisy and still bruises the finish of the car.

A piece of heavy leather substitute the length of the chain which you use, and wide enough to form a tube to inclose the chain, will prove a happy solution of your difficulties.

Get the material at your local upholstery dealer's or from a department-store. Cut it wide enough to allow for turning in the edges.

"Don't tell me you never had a chance!

"Four years ago you and I worked at the same bench. We were *both* discontented. Remember the noon we saw the International Correspondence Schools' advertisement? That woke me up. I realized that to get ahead I needed special training, and I decided to let the I. C. S. help me. When I marked the coupon I asked you to sign with me. You said, 'Aw, forget it!'

"I made the most of my opportunity and have been climbing ever since. You had the same chance I had, but you turned it down. No, Jim, you can't expect more money until you've trained yourself to handle bigger work."

There are lots of "Jims" in the world—in stores, factories, offices, everywhere. Are *you* one of them? Wake up! Every time you see an I. C. S. coupon your chance is staring you in the face. Don't turn it down.

Right now over one hundred thousand men are preparing themselves for bigger jobs and better pay through I. C. S. courses.

You can join them and get in line for promotion. Mark and mail this coupon, and find out how.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7691 Scranton, Pa.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7691,, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ SALESMANSHIP
☐ Electric Lighting and Railways	☐ ADVERTISING
☐ Electric Wiring	☐ Window Trimmer
☐ Telegraph Engineer	☐ Show Card Writer
☐ Telephone Work	☐ Sign Painter
☐ MECHANICAL ENGINEER	☐ Railroad Trainman
☐ Mechanical Draftsman	☐ ILLUSTRATING
☐ Machine Shop Practice	☐ Cartooning
☐ Toolmaker	☐ BUSINESS MANAGEMENT
☐ Gas Engine Operating	☐ Private Secretary
☐ CIVIL ENGINEER	☐ BOOKKEEPER
☐ Surveying and Mapping	☐ Stenographer and Typist
☐ MINE FOREMAN OR ENGINEER	☐ Cert. Public Accountant
☐ STATIONARY ENGINEER	☐ TRAFFIC MANAGER
☐ Marine Engineer	☐ Railway Accountant
☐ Ship Draftsman	☐ Commercial Law
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☐ Contractor and Builder	☐ Teacher
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City_____ State_____

Canadians may send this coupon to International Correspondence Schools, Montreal, Canada 7-28-20

WE all know it does; but how many who use glue know *why*?

Glue does not stick "by itself alone"; but through its capacity to penetrate the fibers and cells of the materials to which it is applied.

Like a thousand tiny tentacles the glue *hooks into*, and *under*, these cells and fibers and joins surfaces securely. That is why green wood cannot be glued satisfactorily — the cells are full of sap.

Iron Glue is the most satisfactory liquid glue. It keeps soft and pliable, flows and spreads readily and will not "dry out" or crack.

Iron Glue

Iron Glue is the perfect adhesive for mending china, glass, crockery, furniture, bric-a-brac, books, toys, etc.
Sold in convenient oval bottles with metal screw top and handy brush. Also in ¼ and ½ pt., pint and quart cans.
At drug, grocery, hardware, department and 5 and 10 cent stores.

McCormick & Co.
Baltimore, U. S. A.

WHITING-ADAMS BRUSHES

Established 1810

THREE WINNERS

Made of highest grade pure hog bristles - stiff and elastic; velvet-like ends.

Perfect working; long wearing brushes. Never fail or shed bristles. Guaranteed in every respect. *Send for Literature*

John L. Whiting-J. J. Adams Co.
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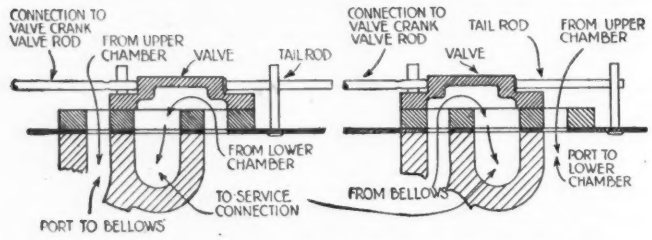
Brush Manufacturers for Over 110 Years and the Largest in the World

How the Gas-Meter Works

By Reginald Trautschold



The action of a gas-meter is identical to that in a simple steam-engine, and the measurement of gas is very accurate

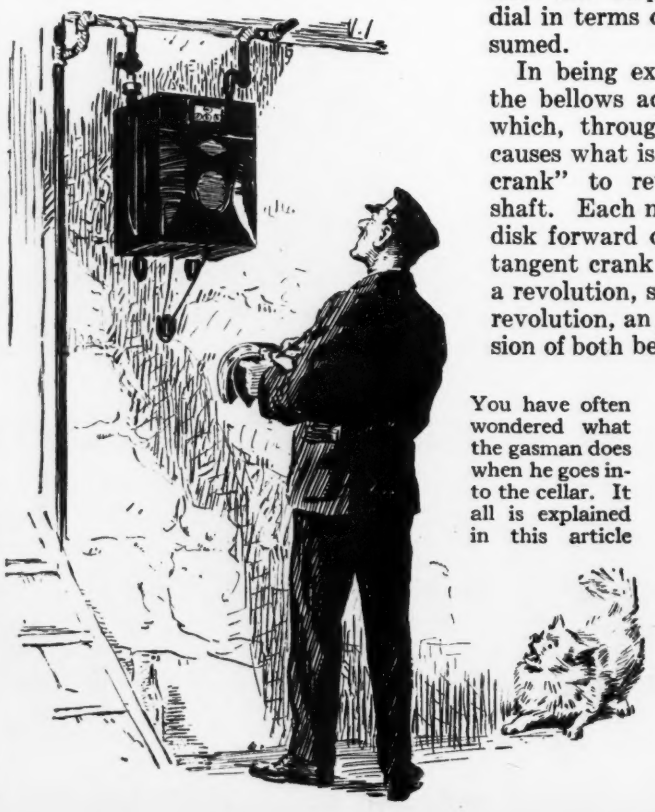
THE periodic visit of the gasman to read the meter is accepted as one of those necessary annoyances of the day of which the why and wherefore are taken for granted. It is true that the meter box is familiar enough to all and many have learned to read the dial, possibly to check up the gasman's readings, but more probably out of pure curiosity. Knowledge ends here, although we ought to dislike to have in our houses such a simple contrivance admittedly not understood.

When the gas-range is going, we can see the little needle of the upper dial move, but what causes it to move and how the consumption of gas is recorded is a sealed secret to most of us. It is veritably a sealed secret, too, for the meter box carries two or more seals which cannot be legally broken; so the mechanism cannot be examined to find out how it works.

Could one dismantle a meter box, it would be found that it is divided into three separate compartments. A horizontal shelf extends across the box a few inches from the top and the lower part is divided into two similar sections by a central vertical wall. Attached to each side of this central partition there is a sheepskin diaphragm, or bellows, ending in a circular metal disk, which may be drawn from the central wall or pressed toward it, much as may an accordion, or the old-fashioned bellows used for starting a fire.

What happens when gas is consumed is briefly this: To begin with, let us suppose one of the bellows to be extended and full of gas. It would then occupy a considerable portion of one of the lower compartments. Gas also occupies the rest of the space in the lower compartment—the space surrounding the extended bellows. When the stove, for instance, is lighted, gas is gradually withdrawn from the bellows, which is then closed by the pressure of the gas about it. As this contraction takes place, gas rushes into the space formerly occupied by the expanded bellows. Now when the bellows is completely empty it fills up again, and of course the gas surrounding the bellows is forced into the service connection. This cycle of operation takes place alternately in both of the lower chambers, the bellows acting for all the world like an accordion, first one side being compressed, then the other. The number of times the bellows is filled and emptied is recorded on the dial in terms of cubic feet of gas consumed.

In being extended and compressed the bellows actuates a type of crank which, through suitable connections, causes what is known as the "tangent crank" to revolve about a central shaft. Each movement of the bellows disk forward or backward causes this tangent crank to make one quarter of a revolution, so that for one complete revolution, an extension and compression of both bellows is necessary. The revolution of the tangent crank causes the shaft operating the dial to turn through a certain part of a revolution. Ordinarily twelve or sixteen extensions of the bellows will cause the dial operating shaft to make one complete revolution of the upper dial needle, registering two cubic feet of gas passing through the meter. The other needles are



You have often wondered what the gasman does when he goes into the cellar. It all is explained in this article

Power-plant dependability—the keynote of Powerplus popularity

Why is the Indian Powerplus so popular? Why is it the eventual choice of every discriminating buyer? You can put the answer in a nut shell, in one word—Dependability.

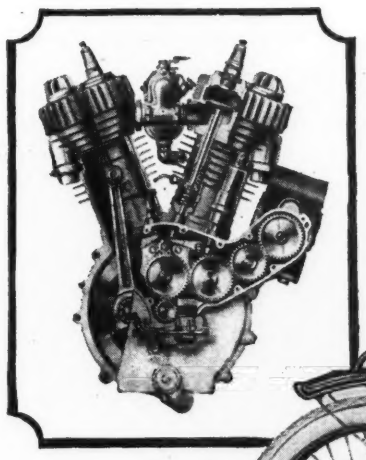
It doesn't matter when or where you choose to go, or how fast you elect to travel, the Powerplus motor is *always* ready to do your bidding—silently, easily, efficiently.

There is nothing accidental about this Powerplus certainty. It is the result of years of painstaking effort and experiment by talented engineers and skilled mechanics.

You can count on the Indian—anytime, anywhere. And, after all, regardless of whether you ride for business or pleasure, you MUST buy *dependability*.

The Power Plant

The Powerplus motor is a high efficiency side by side valve type characterized by great flexibility and high horsepower output. Connecting rods and pinion shaft are borne on roller bearings; driving shaft on bronze bush. Pistons are non-slap, three ring type. All parts are unusually accessible.



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HENDEE MANUFACTURING COMPANY
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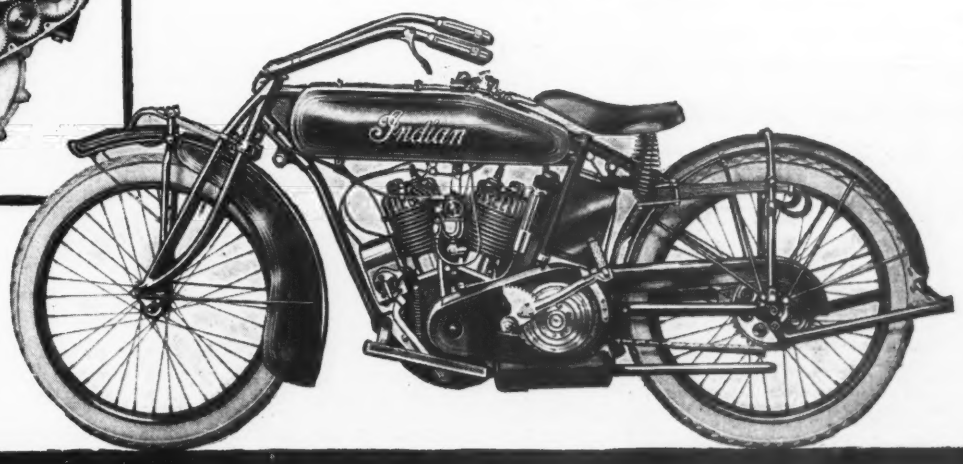
The Largest Motorcycle Manufacturer in the World



Indian Motocycle

For Sale by Dealers Everywhere

Keeps
Little Hurts
From Getting Big

Small skin injuries are liable to become serious. Do not give them a chance.

New-Skin is a preventive and a protection. It is antiseptic, and it forms a covering that keeps out the germs.

Have it on hand and use it promptly when required.

15c and 30c. At all Druggists
NEW-SKIN COMPANY
New York Toronto London

"Never Neglect a Break in the Skin"

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. Guarantee Bond for 8000 Miles. (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write
MELLINGER TIRE & RUBBER CO.
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RAILWAY TRAFFIC INSPECTORS ASSOCIATE WITH BIG MEN

That is what gives them chances for promotion. They start in at a good salary—$110.00 a month and expenses.

The work is important, for the safety of thousands depends on their vigilance. And when they do their work as we teach them they attract the favorable attention of their superiors. Promotions then are rapid.

Learn This Profitable Profession

All you need is a common school education for entrance to our three-month's course, which is easy to learn at home during your spare time. Take the initiative now, while the demand for Railway Traffic Inspectors is so good. THERE IS A BIG DEMAND IN THIS FIELD.

We know of fine openings for our graduates. Many who started our course a few months ago now hold positions.

OUR BOOKLET tells of this ideal vocation—out in the big out-doors—how you associate with big men—how you can earn an excellent salary from the start—how you can climb to the very top. The opportunity COUPON (below) is your key to a better salary now and a much bigger future. Why not send it today! Remember you start at $110 a month, and WE SECURE YOUR POSITION.

Standard Business Training Institute,
BUFFALO, N. Y.

WE ARRANGE FOR A POSITION

Please send, without obligation to me, your Booklet D-100, explaining your Railway Traffic Inspector's Course.

Name .....

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operated from the upper one and register the accumulating consumption.

So much for the principle of operation and the measuring. Now a word as to the mechanism. The gas, which is delivered from the main supply to the upper chamber of the meter box, is deflected from there first to the bellows and then to the surrounding chamber by means of a valve—or rather two valves.

These valves are operated by cranks extending from the same central shaft on which the tangent crank is carried. Their operation is similar to that of the valves operating an ordinary simple, slide-valve steam-engine. The valves fit over three parts leading from the upper compartment, one leading directly to the bellows, another to that portion of the lower compartment not occupied by the bellows, and the third, the central one, directly to the service connection through which the gas is withdrawn as it is consumed. A recess in the under side of the valve is long enough to establish direct passage from one of the end ports to the central one, while the total length of the valve is such that when in either extreme position it will cover two of the ports and leave the third exposed, as in the illustration.

The Mechanism of a Gas-Meter

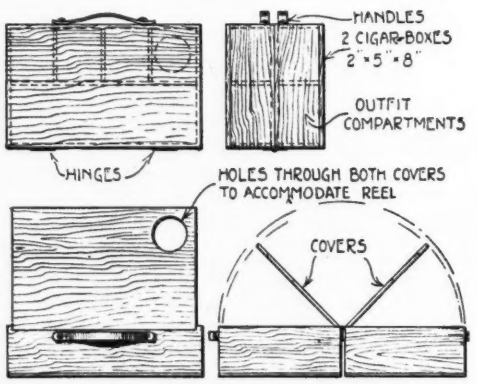
In one extreme position direct communication is open between the upper gas chamber, to which the main gas supply discharges, and the bellows. As the bellows expands, the valve is gradually drawn over the open part leading to the bellows, but while this port remains even partially open, the port leading from the lower chamber is connected through the valve to a passage leading to the service connection; so that as the gas enters the port to the bellows and expands it, the displaced gas passes from the lower chamber through the valve to the service connection. When the port leading to the bellows is closed, the port from the upper gas chamber to the box space surrounding the bellows is opened to admit gas from the upper chambers as the bellows discharges to the service connection through the port now covered by the valve. The action is identical to that in a simple steam engine, and measurement of gas, by recording the filling and emptying of the bellows, is exceedingly accurate.

Before leaving the factory, the meters are tested by allowing a specified amount of air to pass through them and the dials are calibrated so that they will exactly record this volume. To the consumer whose gas bill seems to have increased unduly it may be of interest to know that it is quite probable he has consumed even more gas than the dial records. By law, the calibration of the meter is such that to be approved it must not record more gas then actually passes through. A variation of two per cent is allowed. This variation means that an accepted meter may be one which will allow 102 cubic feet to pass through for each 100 feet recorded. The gas-meter is one of the recording devices which cannot register more than passes through it and wear cannot impair it in this respect.

Two Cigar Boxes Will Carry Fishing Tackle

A TACKLE box that will hold the fisherman's outfit conveniently for him to carry anywhere may be made from two cigar boxes hinged together, back to back. Use two small brass hinges ½ in. wide and with leaves ¾ in. long, secured to the boxes with small brass screws or rivets.

Leave the original covers on the



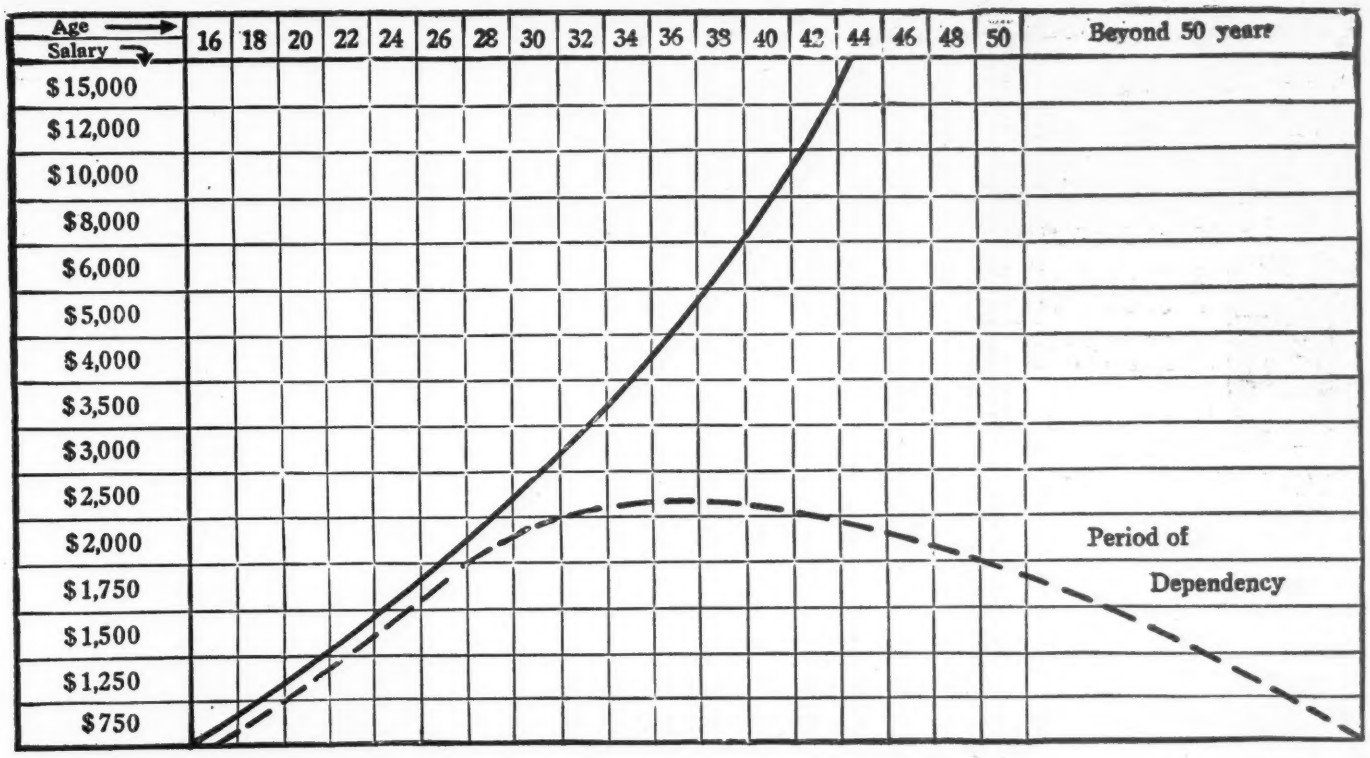
Why buy an expensive fishing-tackle box when you can make one from two cigar boxes?

cigar boxes, and hinge the cigar boxes cover to cover. Use boxes of exactly the same size. A good size for the completed tackle box is 2 in. deep, 5 in. wide, by 9 in. long.

Small locks should be placed conveniently for holding the two parts locked together for carrying. Place two strap handles on the box for carrying. A small lock of some kind should be used in securing the original covers of the cigar boxes so that they will stay closed and keep the contents from spilling when the tackle box is opened.

The interior of each half of the tackle box may be partitioned off into convenient compartments for the articles of the outfit. Small spaces will accommodate the hooks, sinkers, swivels, small spools of wire or line, and other things. Long compartments will carry the snelled hooks, the spoons and spinners, and the folding rule, as well as many other rather long articles. Some space should be especially designed for holding the reel. The handle and top of the reel will need holes cut through the two covers to give them room when the tackle box is securely closed.

Paint or varnish the completed tackle box to suit your fancy. If it is necessary to make it absolutely waterproof the tackle box may be protected by rubber cloth or heavy oilcloth, carefully glued in place.—F. E BRIMMER.



Which Is Your Curve?

TAKE the chart above—go back to the time when you quit school and took your first job—trace in your line on the chart up to the present time. Compare your progress with your ambition. Have you accomplished as much as you should have accomplished? Are you a broken curve man or a heavy curve man? Have you been in a rut or has your advancement been gradual and steady? Be honest with yourself! Are you headed upward toward the executive class—or—are you headed downward on the broken curve toward dependency?

Of the 110,000,000 people in the United States, there is *less than one-half of one percent.* who can claim the heavy, upward-sweeping curve—who are earning $5,000 a year or more. Is it any wonder men capable of earning big salaries are *sought* while others must *seek jobs?*

This chart, compiled, plotted and graphed from authoritative statistics, shows more vividly than words how hopelessly outdistanced is the untrained man all thru life.

The broken curve represents the progress of a man who quits school early in life, takes the first job offered, and makes no effort to improve his education and training along special lines. Youth and physical energy bring fair progress until he is 25 or 26 years of age—then, he hits an almost straight line that shows *no increase in salary for 15 or 20 years.* At 40 or 42 he starts to go down—finally he slides off into the *area of dependency.*

Only four percent. of the men who are 45 years of age—in the very prime of life—have accumulated anything at all. The other 96 per cent have never earned enough to enable them to get one dollar ahead in the game of life.

Now—contrast the record of the *broken curve man* with that of the *heavy curve man*—the man who realized the value of education and training. At 30 the heavy curve man has reached a salary of $3,000 a year. By the time he is 38, he has climbed up into the $5,000 a year class—up among the one-half of one percent. crowd—and is still going up.

Look at the chart again! Note how rapidly the *distance increases* between the two men *after they are 30.* What does this rapidly widening gap mean?

It means that every year's delay on the part of the broken curve man the distance between the two men doubles, trebles, and still increases until, at 40, the broken curve man has many salary squares to climb before he can reach the heavy curve man.

That is just what is happening to thousands of men every day. They are in a race for promotion, advancement and success. But—they lack courage and tenacity—they sit down at the start—others get far ahead of them—then—at the end of 5 or 10 years they wake up to the fact that they have been outdistanced—that they are hopelessly behind.

Every man can be a heavy curve man. He can move upward and forward. Once he has demonstrated his ability and gotten into the executive class, the road becomes easier and his curve will continue to go up. The parting of the ways for the broken curve man comes when he reaches a point beyond which his knowledge and training will not carry him.

Up to that point he is on nearly equal terms with the heavy curve man—the man who is continually preparing himself for further advancement. Then is the time for him to grasp the opportunities offered by one of the thirteen LaSalle home-study training courses in specialized business subjects. Then is the time for him to swing his curve into a heavy upward trend.

Every executive must have special knowledge and training in order to fill his position successfully. He must know what to do, when to do it, and why it should be done. His opinions must be based on actual knowledge and training, and his decisions dictated by his knowledge of the experience of successful business men who have found by actual practice what are the methods to use under every condition of business to insure the best results.

This specialized training you can now secure without interference with your present position. The LaSalle Extension University offers you a choice of thirteen courses of home-study training in highly specialized business subjects. If you are an ambitious man—if you want to succeed—if you want to increase your salary by making your services of greater value—you can do so by spending one hour or more each evening in pleasant, fascinating study and training at home.

You need not wait until you have completed your course before commencing to "cash in" on your training. From the very first day you will begin to develop into a bigger and a better man. You will feel yourself growing daily in self-confidence, courage, knowledge, ability and power. Instead of being afraid to grasp opportunity when it is offered, for fear of failure you will grasp every opportunity with the certain knowledge and confidence that you are able to take fullest advantage of it.

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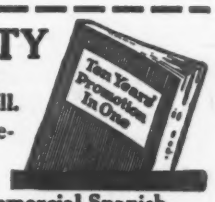

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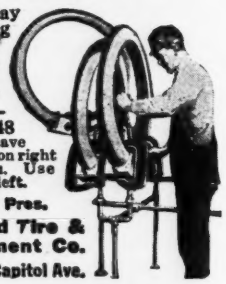

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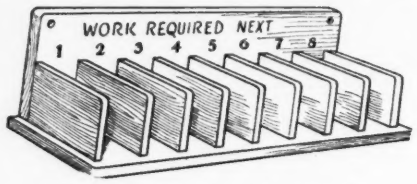
How About That Next Hurry Job?

HOW often have you asked yourself this question? Quite often, we'll venture. Here is how we got over worrying about the problem.

We made a rack as shown in the illustration, and placed the various orders in the order of their urgency.



Don't worry about those rush orders. They are in No. 1 hole. No. 2 is less important

For instance, if an order was in section No. 1, we knew it to be a hurry job. If in 7 or 8, there was no immediate rush. In this way we got out the more important jobs first, but didn't have to go over all the orders to see which one was in an immediate rush.

This same scheme can be used in any line of business and is well worth the effort of making the box.

A Way to Eliminate High-Compression Knocks

OWNERS of old-model automobiles are annoyed by a knocking which occurs under light load. This usually sounds like a carbon or advanced spark knock, while as a matter of fact too high compression is the cause.

Perhaps the most simple method used to reduce high compression is by

FIG. 1

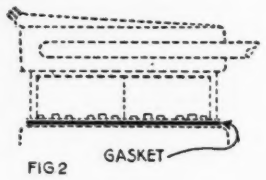
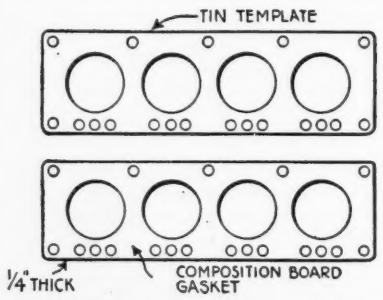


FIG 2



A composition-board gasket will raise your engine cylinders and eliminate high compression and other engine knocks

removing the cylinders and placing a thick gasket between the cylinders and the crank case.

Remove the cylinders. Place them on a bench, cleaning both flange and engine base thoroughly. From a sheet of flat tin make a template, which must be an exact reproduction of the base of the cylinders, except that all the openings, such as piston and bolt holes are

about ⅛ in. larger than those in the cylinders.

The template is used as a pattern for marking out and forming the cylinder-raising gasket. This method permits the gasket to be made without the necessity of placing it under the cylinder after each operation to see that it is right. A copper asbestos jacket cannot be used as a pattern, because sufficient clearance is not afforded.

Procure a sheet of red composition board ¼ in. thick, then, using the template as a pattern, mark out the cylinder and bolt holes and the outside form on the composition board, using a gasket-cutting tool, as shown in Fig. 1, and a drill press, carefully cutting out the piston holes, making these ⅛ in. larger than the diameter of the bolts, with a bandsaw, or keyhole saw, cutting the composition board to conform to the outside shape of the pattern.

Remove all the burred edges with a file. Place the composition board on the engine base and bolt the cylinder into place, as shown in Fig. 2. Care must be taken not to use too much shellac.

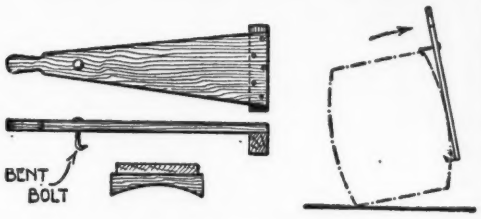
By this means the cylinders are raised, resulting in a larger compression space and, of course, less compression is created. Further, the engine will pull much better and less wear and tear will be thrown upon the engine bearings.

It will be necessary to readjust the valves after the job has been completed.—RONALD L. PRINDLE.

A Labor-Saver for Persons Handling Barrels

WHEN the harvest season comes or when many barrels are to be up-ended and transferred from one place to another, the following idea for up-ending will be appreciated:

Cut out a piece of 1-in. or even heavier plank about the shape shown.



Where barrels are to be handled this device will be a time- and labor-saver

This piece should be the height of the barrel, 10 in. across at the bottom; the top fashioned like a rough handle.

Across the bottom bolt a piece of timber curved on the under side to fit the curve of the barrel. A bent and sharpened bolt is then put through the top of the lever as shown.

When being used, the lever is laid along the length of the barrel so the curved portion comes near the user. Then the hook is caught under the top hoop and the barrel can be lifted easily.

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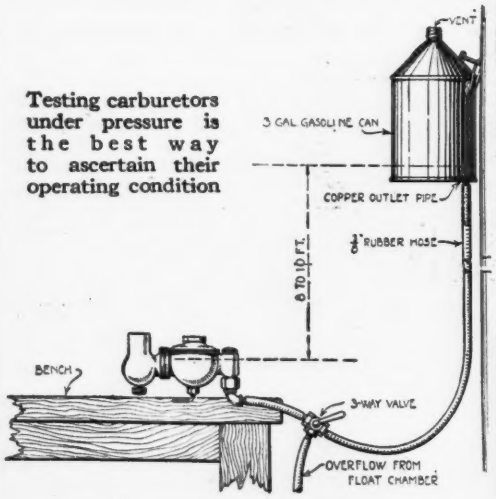
Testing Carburetor with Gravity-Feed Tank

THE needle-valve of a carburetor will often appear tight when tested under the low head of the ordinary gravity-tank installation, but floods or leaks badly if the pressure is increased to several pounds. On the other hand, if it is initially tested under several pounds' pressure, there will be a greater assurance of its keeping tight in every-day use. It is, however, not necessary to rig up an air-pressure tank for testing purposes, as three pounds' pressure is sufficient for most cases, and this may be obtained by a gravity-feed tank placed about ten feet above the float chamber.

The illustration shows a simple rig for the purpose which has proved most satisfactory in testing carburetors. It consists of a three-gallon gasoline or oil can with a short piece of ⅜-in. copper tube soldered into the bottom and projecting about two inches above the bottom in order to form a catch for water and sediment in the can. A can of this size is easily lifted into place and removed for refilling, though one filling lasts a long time, very little gasoline being used during the testing. The can is hung on the wall about 10 ft. above the bench, a loop of iron wire being soldered to it for the purpose. A ⅜-in. inside diameter hot-water hose conducts the gasoline to the testing bench; such a hose will last a long time in spite of the fact that gasoline dissolves rubber.



Testing carburetors under pressure is the best way to ascertain their operating condition

A valve should be placed next to the carburetor, or, better yet, a three-way valve as shown. With the handle in one position, the fuel is shut off altogether. In the second position the gasoline runs from the tank into the carburetor, while the third position allows the fuel to be run out of the float chamber into a waste bucket under the bench and at the same time shuts off the tank. This allows any number of tests to be made and the float chamber to be emptied after each one for the purpose of making further necessary adjustments and repairs quickly without visiting the repairman.—H. H. PARKER.

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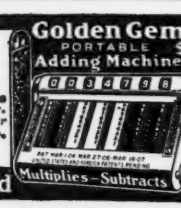

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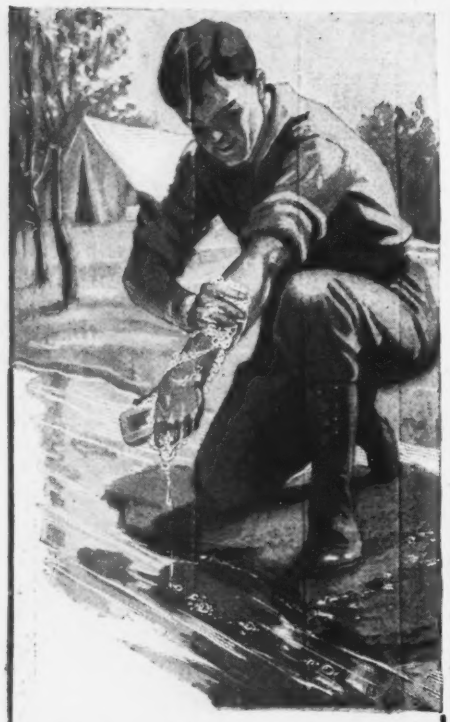

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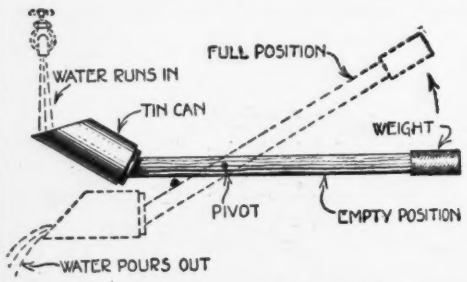
Experiments in Water-Power Signaling

By Windsor Crowell

THE Chinese have a way of pounding grain by water power that has been in use in China for centuries. Strange to say, however, it is little known on this side of the world and deserves recognition because of its simplicity.

While you perhaps do not care to pound corn, you might utilize this idea to do such work as signaling, by flashing lights or ringing a bell. This would be practical at camps, at dangerous points along the coast, or in the forest. Just the idea itself is given here with a few suggestions regarding its use. Its possibilities are so unbounded that the real working out of the problems will be left to the user.

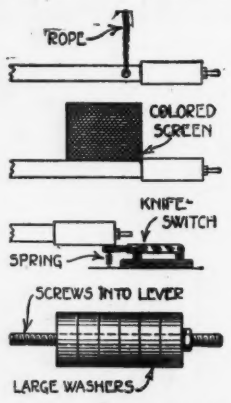


The pull of the returning weight can be made to operate various switches, bells, and levers, which in turn operate various other devices

The ancient Chinese apparatus consisted of a long sweep pivoted in the crotch of a forked stick stuck vertically in the ground. At one end of the sweep was fastened an open gourd to catch a small stream of water sidetracked from a waterfall. At the other end was a stone. As the gourd filled with water its weight outbalanced the stone, and the end with the gourd tipped down. This emptied it and the stone fell to the ground, which lifted the empty gourd to be filled by the stream once more. This operation was repeated indefinitely.

The modern adaptation shows a horizontal stick or timber with a tin can at one end and a weight at the other to hold the stick horizontally when the can is empty.

The size of the stick depends upon the work to be done, but for signaling we will say a stick about 4 ft. long is sufficient. Cut off one end at an angle of 45 degrees and nail a square piece of board at right angles to it. This acts as a base for a large tin can which will hold about a quart or more of liquid. The size determines the rapidity of the oscillations of the lever. The larger the can the longer it will take to fill and the slower it will work.



(*Top*) This method changes the color of a light. (*Bottom*) How a switch is tripped

At the other end of the stick insert a long bolt. The weight is adjusted by slipping on numerous disks or washers and clamping them with a nut. A pivot hole should be bored through the stick at the point indicated. This gives the weighted end a generous leverage to operate on.

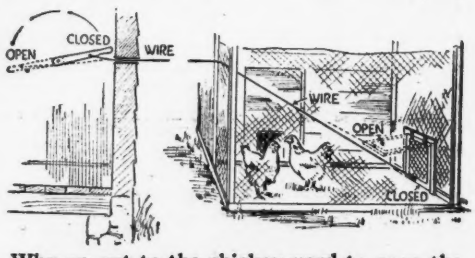
Pivot this lever in a position so that a small steady stream of water will slowly fill the can. When it is nearly full, it should overbalance the weight and tip down to empty; then return to its original position. This return will operate the signal.

Three methods of signaling are herein suggested. In the first the pull of the returning weight pulls the hammer of a bell. In the second suggestion, an opaque or colored screen is attached to the weighted end of the lever. This shuts off or changes the color of a light placed behind it and flashes it on when the lever raises. The third method allows a knife switch to open when the lever tips up and closes it when the weight drops upon it. A spiral spring under the switch lever handle pushes it open when the weight is removed. The circuit can be wired to flash on a powerful electric light at the top of a distant tree or tower, as desired, or ring a distant gong.

Many other uses will suggest themselves to the builder of this water signal and will be worth trying.

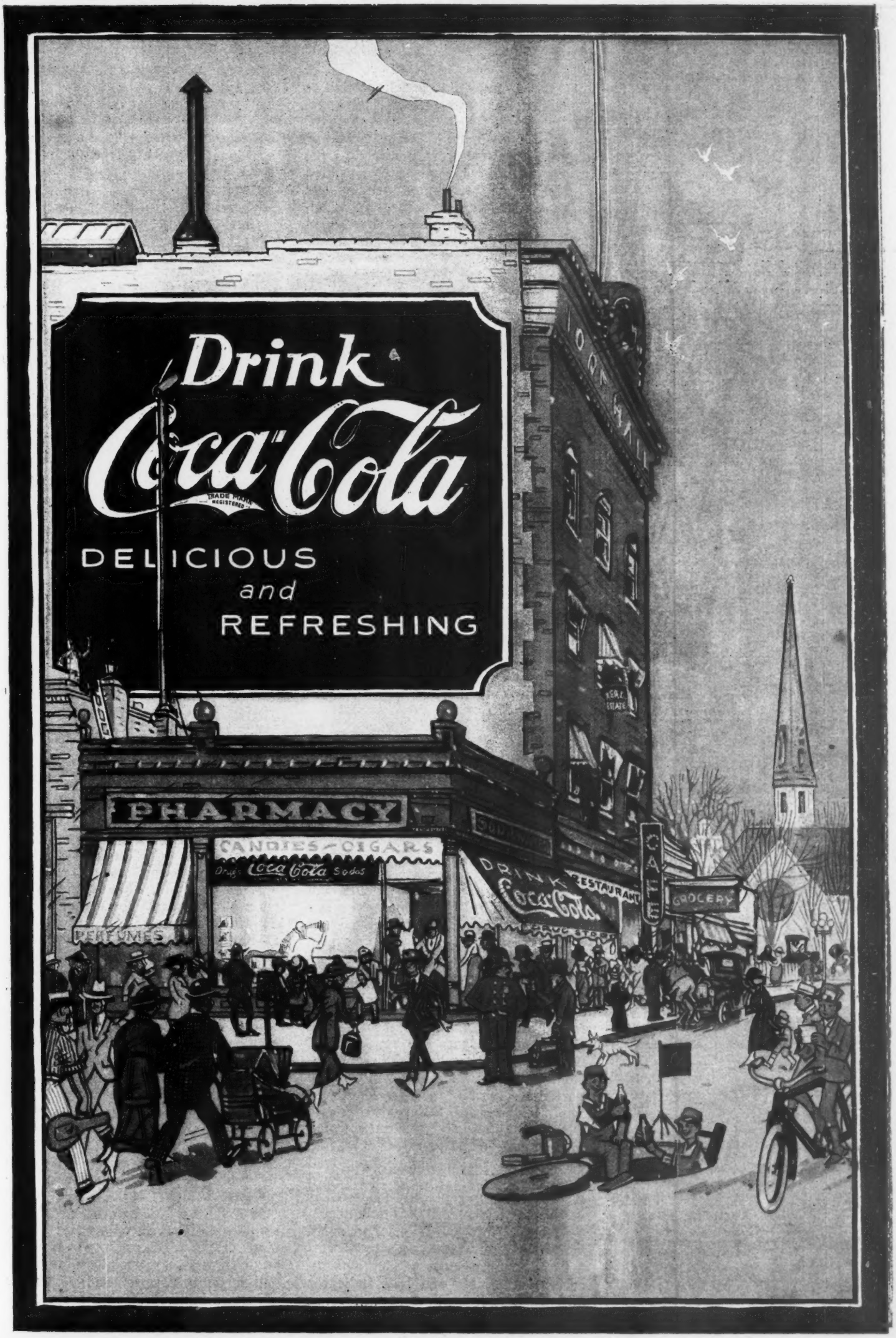
A Poultry-Pen Gate Operated from the House

MANY owners of hens let their feathered flock out of the pen for a few hours each day. This necessitates two trips to the poultry-yard: one to open the gate and a second to close it.



Why go out to the chicken-yard to open the gate? It can be done from inside the house

If a small gate, hinged at the top, is placed in the fence on the side away from the house, it may be opened and closed from a point in the house, even if it is a hundred or more feet away. This is done by means of a wire run from the bottom of the gate over the top of the pen and through a small hole in the wall of the house to a convenient point on the kitchen or pantry wall, where it is fastened to a lever or handle of the gate.—E. R. SMITH.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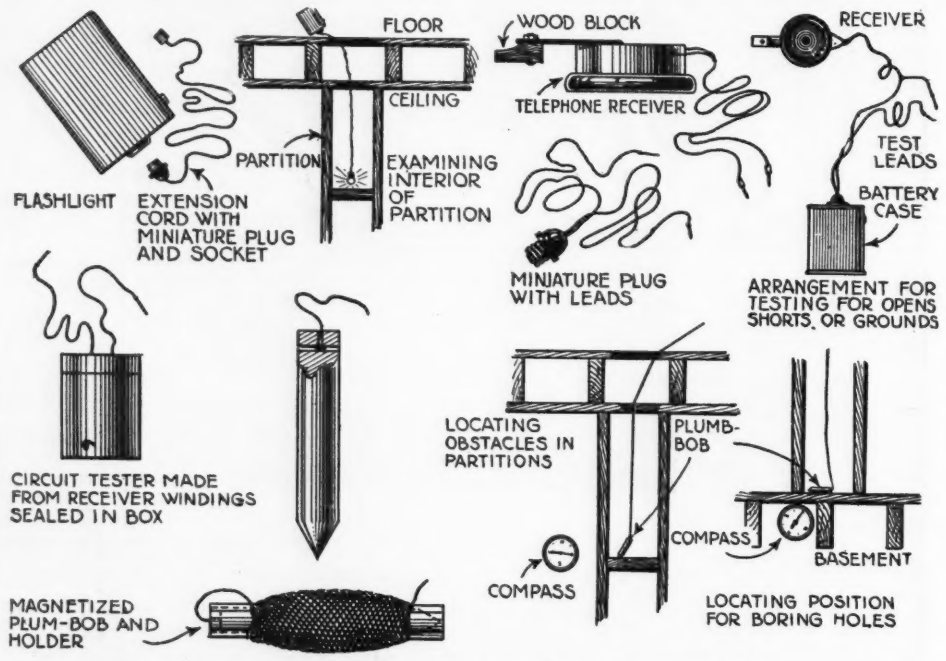
Testing Tips for the Electrician

By **Thomas W. Benson**

FROM time to time I have had to test all kinds of electrical apparatus for trouble, phase out leads, etc., as well as overcome difficulties in wiring. Of course it is possible to get along without special apparatus if a little ingenuity is employed, but it means a lot of lost time. It is entirely feasible to test out circuits by connecting to water and gas mains for juice, and "riff" the receiver off a telephone for an indicator when nothing else is at hand; or standing on a dry board to find a blown fuse with the fingers. But why bother, when a few pieces of apparatus, taking no more room than a small cam-



You who have engines and motors usually need some way of stopping them automatically. Here are six different ways of doing it

era, will save minutes and often hours on the job? Few electricians will have use for all the instruments, but they are handy for the man who has to drop his tools, roll up his sleeves and be ready to tackle anything from repairing a doorbell to wiring an apartment house.

The first requisite is a pocket flashlight. The small flat nickel-plated lamps are the handiest, reasonable in price, and slip into the vest pocket. Alone it is rather limited in application, so for examining the interior of partitions obtain an 8-ft. length of fine twisted wire fitted at one end with a miniature attachment plug and at the other with a miniature socket. The lamp can be removed from the flashlight, the plug screwed in, and the lamp replaced in the socket at the end of the cord. The light can be lowered into partitions and such. Once used you would not part with it.

For testing circuits a telephone receiver is possibly the best indicator and the flashlight battery will serve as a source of current. Fit a set of 3-ft. leads with a miniature attachment plug, leaving the ends of the wire bare. The battery can be slipped into the pocket, one lead run to the telephone, the other leads from telephone and battery acting as testing terminals.

A headband takes up too much room in the kit, so recourse is had to the following scheme: A small block of wood is bolted to the ring on the receiver as illustrated. By gripping this block in the teeth any "clicks" are plainly heard, partly due to the receiver being pointed toward the ear and also to the vibration carried through the teeth and bones of the head. This might be criticized on the point of being unsanitary. The only protective measure the writer has used is to limit the use of the device to himself.

The usefulness of the above instruments is practically unlimited. For instance, extensive alterations were going on in a large building and a number of outlets were to be altered. The service being removed, it would have been quite a problem to pick up live legs to tap in the extra lights without the above. The battery case was simply hung on the feeds to the panel, jumping the outside legs of the three-wire system together. It was possible to pick up live wires by "going in" with telephone on different pairs in various parts of the building.

So much for testing wiring. When it comes to locating opens and blown fuses on power circuits two 110-volt lamps in series are usually employed. This is entirely satisfactory, but the lamps are bulky. If only sockets are carried, sometimes lamps cannot be

obtained, while the little device described here is even less bulky than two medium sockets. The test was made by taking the windings from three 75-ohm, single-pole receivers and connecting them in series. The coils were then placed in a small round wooden box and 12-in. leads run through holes in the cover. The box was filled with melted sealing-wax, the cover being glued firmly into place.

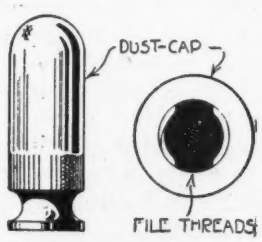
The testing is done by "flashing out," that is, holding one lead on one terminal and tapping the other on the other terminal of the circuit. This test set will pass about 1 ampere on 220 volts and half that on 110 volts. After a little practice the voltage can be readily determined by the size of the flash. The instrument should not be kept in the circuit for any length of time or it will burn up. One of these has been in use nearly two years and is still working.

Another handy device, particularly for the house wireman, is a magnetized plumb bob. There are several makes of narrow steel plumb bobs on the market that can be magnetized and will serve the purpose. One 3 in. long and ½ in. in diameter is about right. If desired, it can be made from a steel rod by drawing the temper and drilling as shown in the illustration. The point is ground and the rod hardened. It can then be magnetized, either by rubbing on the poles of a direct-current machine or by enclosing in a coil of wire and passing a heavy direct current.

The bob, in addition to its usual purposes, is to be used in connection with a compass to locate outlets through walls and ceilings and show the positions of horizontal studs in a wall or partition. How the writer utilizes it can be seen in the illustration. Dropping it down the partition a compass is used to locate it. It thus reduces the wall cutting to a minimum and speeds up the work.

Save Time When You Are Inflating Tires

TIME spent in unscrewing the dust caps in order to inflate tires may be saved by filing inside of valve cap on two sides with a rat-tail file so that the cap will slide down on the valve stem. When you want to remove cap, just push cap down hard and turn to the left so that the threads on the valve stem will be in the grooves in cap, when cap can be removed without unscrewing.



The cap can simply be turned and pulled off, not unscrewed

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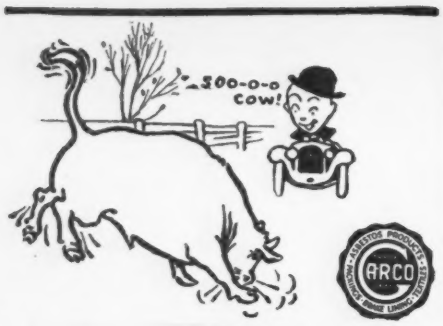

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Popular Science Monthly, 225 West 39th St., New York

Storing Away the Summer Shower

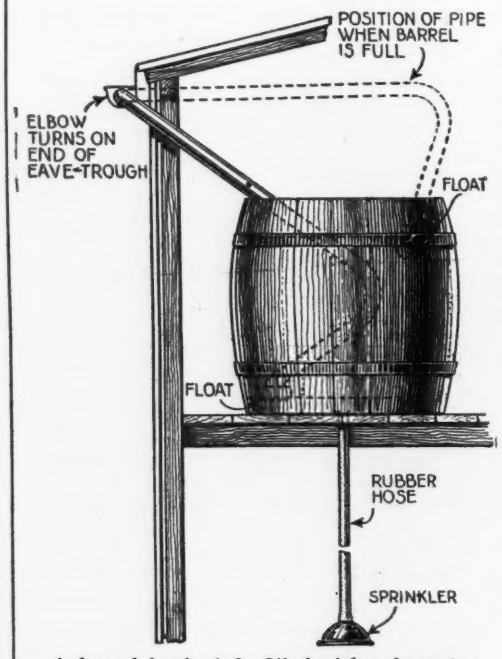
By Dale Van Horn

A SIMPLE shower with an April-rain effectiveness was made as shown in the accompanying illustration. The reason for its being was that a number of boys, deprived of the old swimming-hole, and disdaining the conventional tub variety, sought a more primitive type of shower.

A barrel was taken to the attic of a machinery shed and placed near the eaves as shown. A length of eave-trough was fastened in place along the edge of the roof nearest the spot occupied by the barrel, and an opening was made for a second pipe, to run through the side of the building, on a line between the barrel and the open end of the eave-trough.

A hole in the bottom of the barrel large enough to take a section of garden hose, and a hollow wood bung completed the plumbing from the barrel down. The hose was made secure in the barrel bottom by inserting one end of it through the hole and driving the hollow plug into it from the inside of the barrel. The hose ran down to a convenient height above the floor below and the other end was provided with the flared sprinkler head from an old flower sprinkler.

Now, to complete the arrangement, two lengths of cistern pipe, connected by an elbow and with a second elbow on one end, were run from the open end of the eave-trough into the barrel, the lower end of which, was supported



A barrel in the loft, filled with rain-water from the roof, gives one a real shower-bath

on the surface of the water by a wood float. The hinged pipe turns on the end of the trough. When the barrel is nearly empty, the pipe slopes down so that rain-water, running from the roof, is caught in the trough and transferred through the pipe to the barrel. As the barrel fills, the float rises, lifting that end of the pipe, and when nearly full tips the pipe so that it slopes in the other direction. The rain-water then runs the other way.

This original arrangement was so primitive that a kink in the hose served as a shut-off, and in order to get his shower, one must unwind the hose from two nails driven in a stud-

Deprived of the old swimming-hole, a home-made shower-bath will keep you cool

ding. However, a valve may be easily inserted above the sprinkler attachment. If there isn't a machinery shed handy, use that old barn or granary.

It will be found that a barrel of water will, if used with discretion, serve several individuals once, or one individual several times, with a choice, soft-water bath. The water, standing by day under a warm roof, has the chill taken off in the evening. Build a board platform on the floor if it is of earth, provide a drain to the outside of the building, and enjoy a bath every night—if it rains often enough.

A Waterproof Cement for the Camper

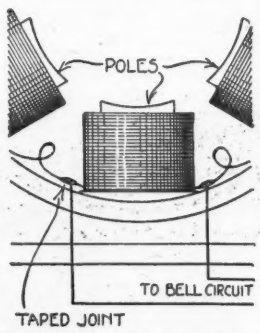
VACATIONISTS who have camped out under canvas and been up against a leaky tent without the wherewithal to repair it will be interested in the waterproof cement now obtainable for just such emergencies.

When used to stop up a pinhole in a leaky tent, a drop of it will make a water-tight seal, impervious to moisture. It is flexible so that it will permit of folding the canvas without cracking.

This new cement is also excellent for mending torn clothing, boots, blankets, broken fishing-rods, tennis-rackets, or anything that is subjected to moisture or dampness. It comes in a small tube that takes little space in the camper's pack and is absolutely essential.

Electric Bells Rung Directly from Large Generator

A NOVEL method of operating the call bells in a large factory directly from a high-voltage generator is shown here. The foreman was annoyed by the bell batteries running down every so often, so he proceeded to utilize the power from a large dynamo in a novel way. It was a six-pole direct-current machine.



In place of batteries a generator rings the bell

One of the poles was utilized as shown.

The wires connecting this pole to its two neighbors were scraped clean close to the windings, and one bell-wire soldered to each one. The joints were then taped to prevent short-circuiting and the bell wires connected up in the usual manner.

The revolutions of the armature were so rapid that no breaks in the bell current were noticeable and sufficient current was furnished to operate all the bells in the factory, but the current was not strong enough to burn them out or injure them in any way.

This Homemade Carbon-Scraper Works Well

CARBON causes more trouble and loss of engine power than any other engine fault. Although many people believe that in order to dislodge carbon from the engine a removal of the pistons or engine head is necessary, the ejection of the carbon may be accomplished simply through the hole left upon the removal of the spark-plug.

Get three lengths of steel clock-spring, preferably about 3/8 in. wide and 10 in. long, and, after removing the temper from about 4 in. of the end,

This kind of carbon-scraper cleans the carbon from the cylinders quickly

bore two holes through them and mount in handle. The holes will allow the handle screws to pass through the spring, holding it firmly in place. The free ends of the springs should be ground rounding.

Turn the engine crank over until the piston in the cylinder upon which the work is to be done is at the top of its stroke. Insert the scraper and move back, forth, and around inside until some of the carbon is dislodged. Remove this loose carbon by inserting a tire pump through the spark-plug hole and blowing.

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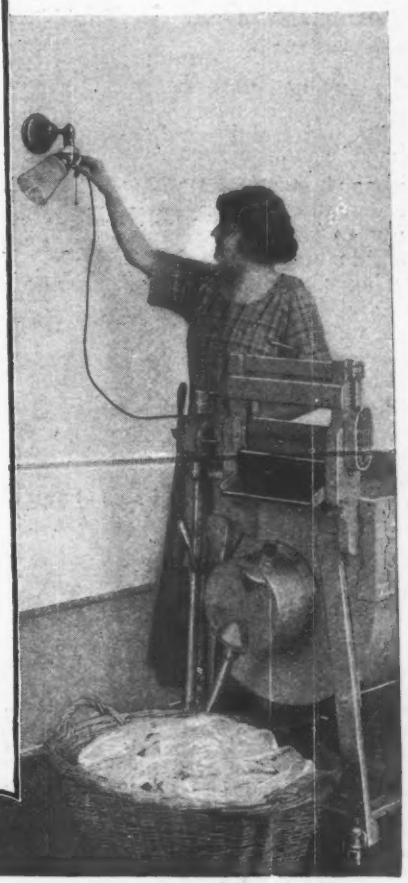

The cord used on the Washing Machine shown in the picture is fitted with a Benjamin 903 Swivel Attachment Plug which screws into the socket without twisting or damaging the cord. Ask your dealer to equip the cords of your appliances with it.

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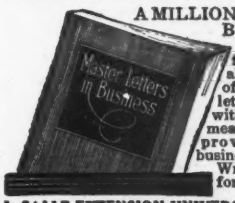

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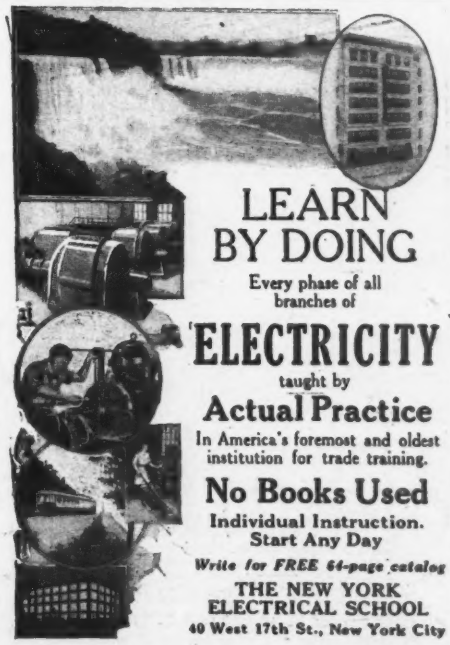

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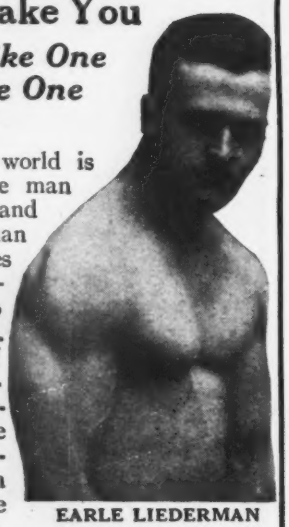

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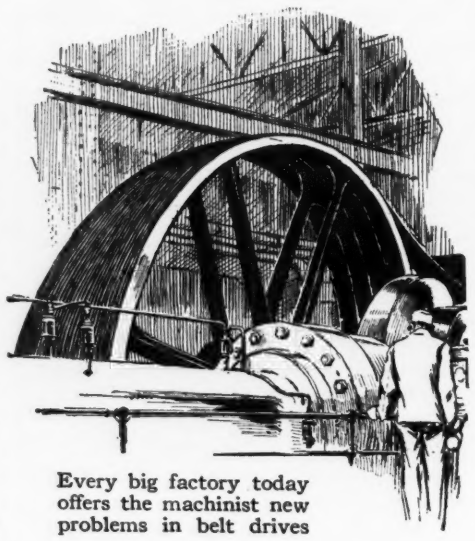
Some Unusual Belt Drives

By R. C. Leibe

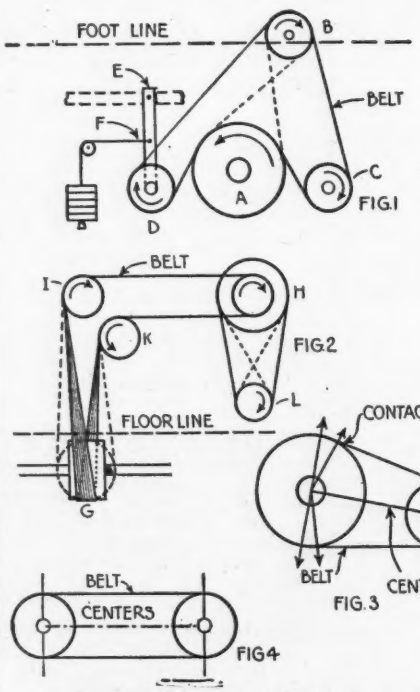
IT has been the writer's lot to design and install many unusual belt drives to accomplish a given end. A few are herewith shown in the illustrations which doubtless will be of interest to many readers who may wish to gain the same ends in power transmission. Crossbelts, when used to reverse the turning direction of the driven machine from that of the driveshaft, whether large or small, are to be avoided when possible. While they have a slight advantage over the straight-belt drive in pulley-clinging ability, they are subjected to much wear on the inside as the cross rubbing causes much friction as well as the uneven strain brought on the belt by its twisted condition as it passes over the pulleys reversing the directions of travel of each.

Figure 1 shows an unusual heavy drive which transmits 30 horsepower from the main-line shaft to the driven machine. It is given to show that it is very effective and can be used as well in heavy drives as with light power drives. This arrangement was designed to avoid the dreaded crossbelt transmission and yet reverse the direction of travel of both the driver and driven pulleys which would otherwise require the use of a crossbelt. The power is transmitted by an endless leather belt (two-ply) and kept tight with the aid of an adjustable press pulley.

Referring to *A*, line shaft-driver, the arrow points direction of travel. *B* shows location of driven machine, and the arrow shows its travel as opposite that of the driver. At *C* is shown stationary guide pulley, while at *D* is the press pulley or idler, which is self-adjusting to the stretch and pull of the belt. Its upper frame is hinged at *E*, and pulling cable, sheave-wheel, and weight are shown at *F*. Arrows on both guide and idler show travel direction of belt. Cross-dotted lines show the position of a crossbelt if such were used to reverse the power direction.



Every big factory today offers the machinist new problems in belt drives



Figures 1, 2, 3, and 4 illustrate some belt drives that are out of the ordinary

Figure 2 shows plainly another unusual power drive. It is a means of forming a square in power transmission with a single belt, known as a quarter-turn drive, in that the face of the driver pulley forms square with the side of the driven pulley. In other words, owing to lack of space, or for convenience, many times a machine is desired set at a right angle to that of the main-line shafting or counter shafts, in which case a quarter-turn belt drive is necessary. Again, as a quarter-turn belt proves a great trouble-maker when used direct from the drive pulley to the driven, it becomes a matter of overcoming this defect. Figure 2 shows how the writer designed a method which proved highly satisfactory.

At letter *G* is shown the drive-pulley face, while *H* is the driven counter which leads to the machine at *L*. At *I* and *K* are the mule pulleys which act as idlers (stationary) and also produce the desired quarter turn of the belt without ill effects.

Arrows point the direction of travel of each pulley in the battery. The dotted lines from drive upward show how the same arrangement can be used as a step-over drive to a given machine when in line with driven.

The upper mule pulley at *I* is slightly misleading in sketch to show the position of belt clearly, in that the outer edge of mule pulley should be in line with center of driver pulley below at *G*. Then belt will run true throughout the arrangement of pulleys.

Figure 3 shows ways and means of securing belt lengths quickly. The same rules cannot apply to Figs. 3

and 4, the difference being that upper sketch shows one pulley two thirds larger than the other, which requires this rule: Add the two diameters, in feet, and divide by 2; multiply this by 3.16, and add twice the distance between the centers of shafts. The result gives the length of belt required. Or if one pulley is a trifle less than two thirds the size of the other, multiply by 3.25 instead of 3.16, other measurements being the same. Arrows on sketch show plainly why this is done.

Note center lines and other lines showing where or at what point the belt leaves the pulleys. With the large pulley, this point is past the center; with small pulley, not quite to center.

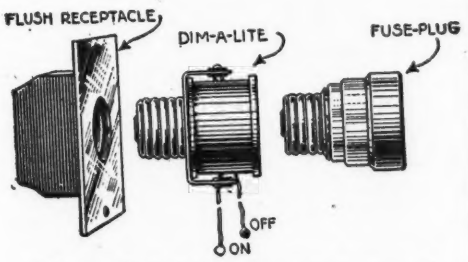
This may explain why many mechanics make mistakes in relation to same.

Figure 4 shows two pulleys of the same diameter. For belt length, add to the circumference of one pulley just twice the distance between centers. The result is the length required for the belt.

This explains why both rules do not apply to both cases.

Don't Snap a Switch and Wake the Baby

IN hospitals where a night light is wanted, or where the noise of an ordinary snap switch will disturb a nervous patient; in bedrooms, or in the hall, for father when he is out late, the switch here illustrated should prove indispensable. It is easily assembled from standard parts that may be bought at any electrical supply store, and is inexpensive.



When pulled, this easily made "no-snap" electric-light switch will not wake the baby nor annoy the nervous patient

Remove the switch from the wall box, if it is of the flush type, and substitute a flush receptacle. Cover it with a plate without a hinged cover. If the wall switch is not of the flush type, remove the switch and substitute for it an exposed type of screw receptacle. In the receptacle screw a dim-a-light and into the dim-a-light an ordinary fuse plug. This is all there is to it and the switch is complete.

You now have a switch that will give you four graduations of light, "off," "low," "middle," and "full." Now when you have to get up at night to put out the cat, "low" gives just enough light to enable you to see your way about the room and there is no "snap" to rouse the baby.—M. KENT.

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The Bouncer and the Tramp Molecule

The story of the modern vacuum pump

IN air at ordinary room temperature and under the pressure of the atmosphere above, there are about four hundred million million million molecules in each cubic inch. It would be a poor pump which could not make a partial vacuum by removing some of these molecules, but it would be a most wonderful one which could remove them all.

Air-pressure depends upon the number of molecules per cubic inch. As the air is removed from a vessel the pressure of the remaining air falls. Its value is always proportional to the number of molecules per cubic inch which remain. With a carefully made cylinder pump, with valves working in oil, the pressure may be reduced to a millionth of normal atmospheric pressure. Then each cubic inch would contain a mere matter of four hundred million million molecules, a figure only to be compared to present-day national debts. So far as pressure is concerned, this would mean a pretty good vacuum, but there are a few molecules left after all the pumping.

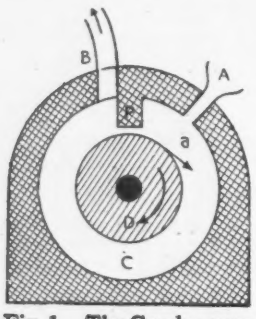

Fig. 1. The Gaede pump bounces the molecules by a revolving drum

The ordinary vacuum pump depends for its action upon the fact that gases, like air, expand indefinitely. Such expansion is due to the ceaseless motion which is characteristic of molecules. In their motion they are constantly crowding and jostling each other into any space that may be available for their travels. In the piston type of pump, one direction of stroke decreases this space and at the same time creates a partial vacuum in the pump cylinder. The pressure of the air in the vessel which is to be evacuated, therefore rises until it lifts the valve, and some of the molecules surge into the pump cylinder. On the return stroke these molecules are crowded together, that is, there is compression in the cylinder until they force their way through another valve into the outer air.

To remove a larger portion of the molecules of a given vessel than is possible with such a pump, scientists have devised so-called "molecular pumps." These operate on a somewhat different principle. They act on the principle of the "bouncer" of the old-time tough joint. The idea is to catch one molecule at a time and to give it a well-directed shove toward the exit. But if that is the method, it will work only if there is a fairly clear pathway between the bouncer and the exit. If too many molecules are moving between the bouncer and the outlet, then the molecule which is given the shove may be jostled back into the space where its presence is unwelcome.

"A vacuum," says the dictionary, "is a space devoid of matter." Of what interest is such empty space to you or me? Why should scientists be always trying to obtain a space entirely free from matter? Your doctor and your dentist will tell you that a good vacuum is essential in X-ray tubes such as they use for the diagnosis of hidden ills in the body. The radio operator will say that the most sensitive devices which he uses in receiving the feeble electric waves from distant stations are vacuum tubes. The telephone-equipment man will refer to them as the means by which long-distance telephony is possible, whether by wire or wireless. The electrical engineer uses vacuum tubes of large size in rectifying alternating currents to get direct currents such as are necessary in charging storage batteries. The scientist, and the dreamer of a future when hidden stores of natural energy shall be released under man's control, will tell how in highly evacuated tubes he is tearing to pieces the tiny invisible atom and learning the secret of its structure and the cause of radiant energy such as the sun's light.

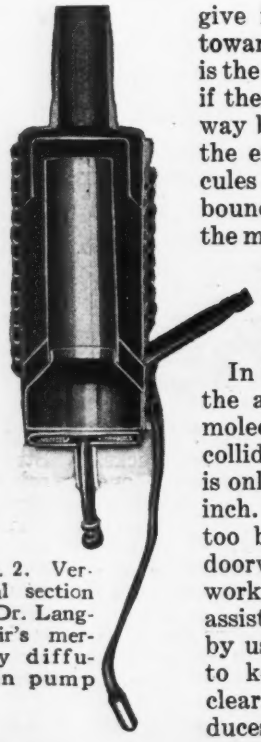

Fig. 2. Vertical section of Dr. Langmuir's mercury diffusion pump

In air, at ordinary pressure, the average distance which a molecule may travel without colliding with one of its fellows is only about a millionth of an inch. There would then be too big a crowd about the doorway for the bouncer to work, so he must receive assistance. This is obtained by using a "roughing pump" to keep the doorway fairly clear. Incidentally this reduces the density of the molecular crowd until the average path of free motion for a molecule is about one third of an inch. Now, let a molecule be caught by the bouncer, and a few good shoves and out it goes.

In the Gaede pump the bouncer is a revolving drum. In cross section it is shown as *D* in Fig. 1. The vessel to be evacuated is connected at *A*. An ordinary or roughing pump is connected at the exit marked *B*. The separator *P* prevents a molecule from sneaking from the exit to the entrance.

Suppose, as is certain to happen, that a wandering tramp of a molecule comes in at *A*. Very shortly he is up against the bouncer, which gives him a shove in the direction shown by the arrow marked *a*. He bangs against the walls of the circular chamber and back again into the arms of the bouncer and thus inevitably toward the exit *B*.

Fig 3. In this pump mercury molecules do the pumping

With this Gaede pump it is possible to obtain vacua about a thousand times better than with the best oil pumps. The pressure in the vessel *A* is thus reduced to less than a billionth of normal atmospheric pressure.

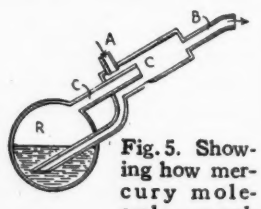

Fig. 5. Showing how mercury molecules work

There still remain in *A* about a hundred billion molecules per cubic inch; but molecules are so small that one of those which remain travels back and forth between the walls for a matter of 1200 feet or so before it collides with another molecule. Each molecule suffers about one collision a second, which is not very often considering the crowd.

In the Langmuir condensation pump which was developed in the laboratories of the General Electric Company, molecules of mercury vapor are used for bouncers.

Fig. 4. The Langmuir pump with a motor-driven roughing-pump

There are billions of them, so that it is a lucky molecule that gets by them. Figure 2 shows the pump in vertical cross section. In Fig. 3 it is shown assembled, and in Fig. 4 we see it

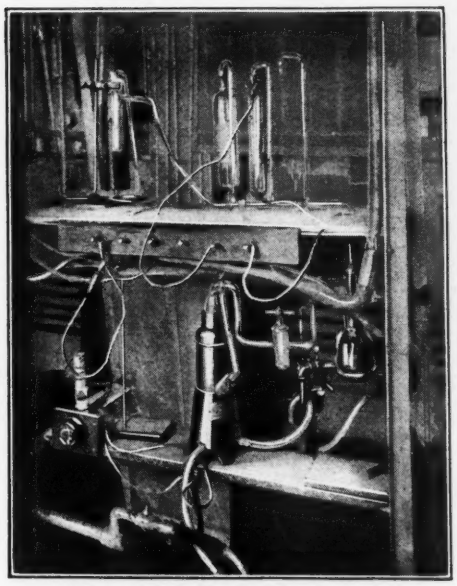

Fig. 6. Showing the use of a mercury diffusion pump in a well-equipped research laboratory

mounted beside a motor-driven roughing pump.

The principle upon which Dr. Langmuir's pump operates is easily understood by consulting the diagram of Fig. 5. The explanation is taken from Mr. John Mills' book, "The Realities of Modern Science" (Macmillan, 1919):

> The roughing pump is connected at B and the vessel which is to be evacuated at A. The reservoir R contains mercury which is heated and boils. The mercury molecules rise in a dense stream and shoot through the tube *c* into the chamber C. Molecules of the air entering at A get in the way of this stream and receive a motion toward the outlet at B. The chamber C is cooled by a water jacket (not shown in the sketch) and hence the vapor molecules condense on its sides and trickle down again into the reservoir R.
>
> At the upper end of the chamber C there are some molecules of mercury, but these are much reduced in velocity by the cooling and but few of them find their way back, against the stream, into the region A.
>
> The limit of the vacua to be obtained by the use of a pump operating on this principle, does not appear to be inherent in the pump itself, but to depend upon the character of the walls of the vessels, particularly that which is to be evacuated. These walls are not smooth and solid, but are a granular structure of molecules. Within the spaces between these molecules there may be a number of gas molecules. These diffuse into what we usually consider the free space of the vessel, but do so comparatively slowly because of the network of molecules past which they must thread their way. Gas, which is thus occluded by the walls of the vessel, is probably the real limit of the vacuum which may be obtained, or otherwise, sooner or later, every molecule in the vessel A would find its way into the chamber C.

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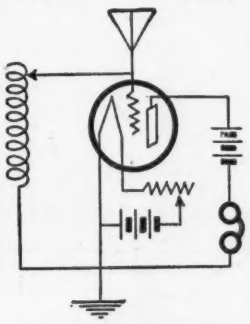

A simple hook-up for an audion detector

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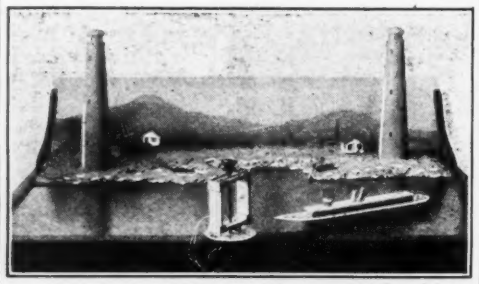
Here Is a Complete Model Fog-Signaling System

BY the use of a working model, the U. S. Bureau of Standards is enabled to demonstrate the radio fog-signaling system and radio compass as employed by the government. Two



A working model of radio compass perfected by the United States Bureau of Standards

lighthouses in miniature are equipped with automatic radio-transmitting apparatus, the compass being located on board ship.

The working model impressively illustrates the method of locating a vessel by means of a radio compass. The compass coil is shown in the foreground of the photograph. As this coil is rotated on its axis, the radio signal from the lighthouse decreases in intensity until the minimum point is found, at which designation the indicator is pointing toward the lighthouse which is at that time transmitting signals.

Differing from actual practice in radio fog-signaling, each lighthouse on this model is equipped with a buzzer which shifts automatically by means of clockwork situated beneath the lighthouse. By the automatic operation, the signals are transmitted alternately from one lighthouse to another every ten or fifteen seconds.

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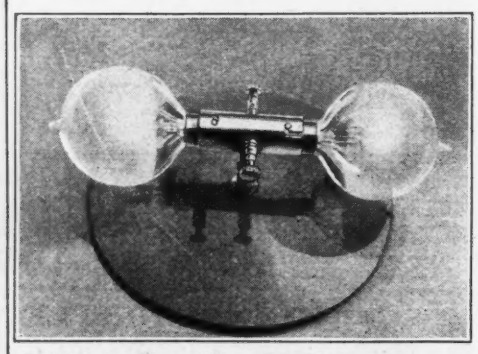
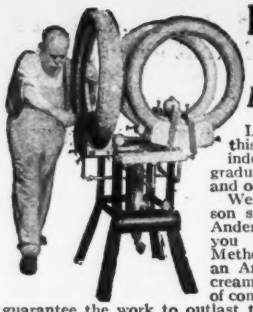
NEARLY every one who experiments with vacuum valve-detectors is interested in the use of these tubes as rectifiers, for changing from alternating to direct current, but the majority do not wish to run the risk of using expensive tubes for this purpose.

Those who wish to use vacuum tube rectifiers will find the instrument described herewith satisfactory, and at the same time they need not worry



Double-valve rectifier of half-ampere capacity made from automobile headlight lamps



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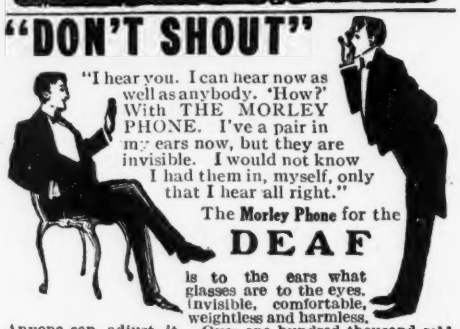

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about cost, as the bulbs retail at about sixty-five cents each. Moreover, they are of very rugged construction and will last for a long time.

All that is needed to construct an instrument of the type mentioned above is one or more double-contact bayonet sockets, such as are used for any automobile electric-light bulb. The long double connecting socket shown in the picture herewith is the most economical, as it costs but twenty-five cents, and can be cut in half and two complete sockets made from it by sawing all *metallic* parts in two. The composition center will then hold the parts together.

The bulbs used as rectifiers are the bayonet-base type, round automobile headlights of the double-filament type, just recently put on the market for the Ford automobile. One filament should be burned out by an over-voltage current applied to the proper terminals. The connecting wire and all that remains of this filament coil can then be used as the plate, and the remaining filament, which consumes only .85 amperes, can be used to supply the electron stream.

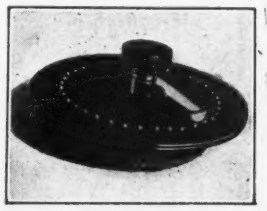
The usual alternating current can be fed to the filament and plates of these bulbs when suitably reduced by transformers, and direct current taken out in the manner usual with such devices.

These tubes will pass about 0.5 amperes each under suitable conditions.—R. U. CLARK, 3D.

Solid-Silver Switch-Points of Low Cost

SOLID-silver switch-points for loading coils and receiving transformers such as are used with the average radio set are much to be desired, but generally taboo on account of the usual high cost of such parts.

In the loading coil shown herewith the contacts are of solid silver. They were made from the beads of a silver necklace. Each bead has a small hole through the center in which the wire terminals from the coil, or a small brass bolt, can be inserted, and if desired soldered with a very small soldering-iron.



Silver beads and a phonograph record form this dial

The beads cost about two dollars a hundred for the one-eighth-inch size, larger beads costing more in proportion, but even the largest only figure out about three cents each, which is very much cheaper than the cost of even a silver-plated switch-point.

In the instrument shown here the beads are mounted on a small ten-cent disk record which in connection with a neat knob and silver-plated switch-arm makes a very fine-appearing instrument. The end of the

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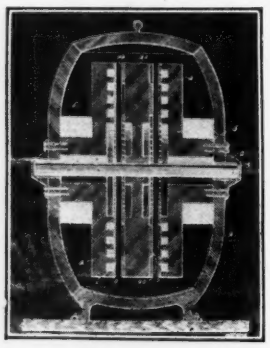
switch-arm can be made in the form of a semicircular cup or depression if more contact surface is desired. At any rate, the very highest efficiency can be had from contacts of the type just described.—R. U. CLARK, 3D.

A Generator of the Uni-Polar Disk Type

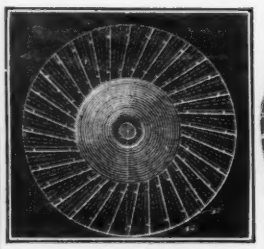
THE theory of this machine is the same as that of the drum type. In the drawings *A* is a vertical axial section through the generator. This and the other figures are reproduced from the drawings in my patent. Diagram *B* is a face view of the rotor and *C* is a face view of one of the stators.



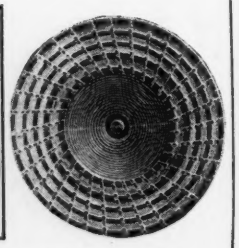
(*A*) Cross-section of a disk-type generator needing no commutator or brushes

A pair of stators is secured to the frame, the stators being disks and arranged coaxially with the shaft, and the rotor is secured to the shaft and is arranged between the stators.

Each stator has a hub, 5, which is secured to the frame. The field windings, 6, are arranged on these hubs between the frame and the disk. The inner face of each disk, 4, that is, the face remote from the hub, has a series of annular grooves in which are arranged the armature windings. The face poles, 9, are arranged in series, each series being at a tangent of 11¼ degrees. Air gaps are provided between the members of the series, as will be evident from an inspection of *C*.



(*B*) Rotor with tangential face poles for continual movement of magnetic flux



(*C*) The stator of the disk-type uni-polar generator

The rotor is a disk of annealed wrought iron, secured to the shaft. The face poles, 12, which are also of annealed wrought iron, are placed upon the opposite face of the rotor at tangents of 11¼ degrees.

When the rotor turns, the magnetic circuit is moved out toward the periphery of the stator. Therefore, every 22½ degrees that the rotor turns, all the magnetic lines will pass through the armature coils, producing in them a continuous current.—O. S. MOCK.

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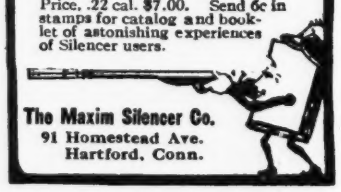

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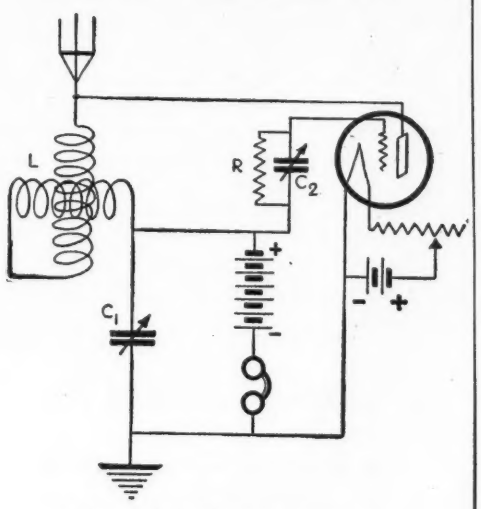

A simple and easily tuned regenerative circuit with amplifying effects on spark signals

by pencil lines on a piece of paper, and should be adjusted by the usual method of drawing more lines until the bulb oscillates properly, and then should not be readjusted. L is a variometer.

The tuning is done entirely with L and C_1. A tapped inductance may be used in place of a variometer, with a slight sacrifice of selectivity. For long wave-lengths the inductance must be increased by adding a coil in series with L. The circuit may then be used through a range from 200 to 20,000 meters.—BURNETT TYLER.

S.O.S. Received from a Wrecked Seaplane

NO doubt many of us have seen reports of seaplanes being forced to alight in the water because of engine trouble or some other causes and having summoned aid by means of wireless.

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On a seaplane the aerial is a wire unwound from a reel which trails *downward*. When the machine is forced to alight on the water this trailing aerial is put out of action at once and wireless communication is out of the question.

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The telescopic mast consists of four lengths of tubular wood telescoping one into the other. It measures 10 ft. when closed and 33 ft. when extended.

Four aerial wires stretch from the top of the mast, two going to the wing tips, one to the rudder post and the fourth to the wireless cabin. These wires also act as stays to the mast and obviate the necessity of other stays. The mast can be erected a few minutes after descent.

The kite aerial is commonly used for two-seater seaplanes; the telescopic mast for flying boats.—G. H. DALY.

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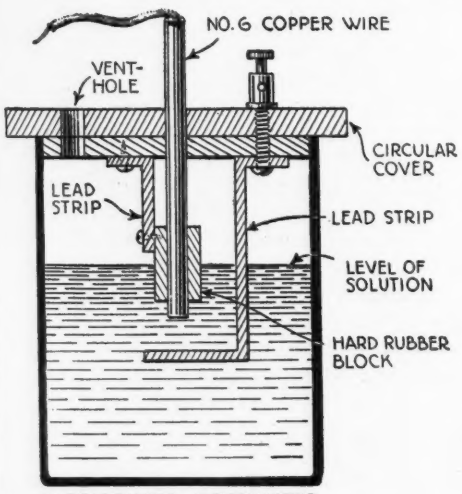

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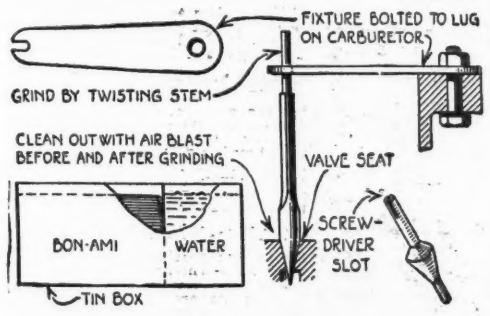
An electrolytic interrupter of simple construction suitable for use in small transmitting sets

rubber. A small hole is drilled through this block from end to end, and reamed out until the heavy wire fits in it snugly. A similar hole is drilled in the cover. The two lead strips are bent L-shaped and fastened as shown in the illustration. The heavy wire is pushed through the holes until about $\frac{1}{8}$ in. projects beyond the block.

To use the interrupter, fill the jar with clean water until it reaches a level about half way up to the rubber block. Then connect the interrupter to the spark-coil and the source of current. Pour sulphuric acid, drop by drop, through the vent-hole until the interrupter starts and a heavy flame jumps the gap. Occasionally the wire electrode must be lowered by pushing through the block, as it gradually wears away.—HAROLD J. HASBROUCK.

Grinding Carburetor Needle-Valves Accurately

WHEN a carburetor floods, the usual source of trouble is a leaking needle-valve, perhaps due to dirt getting in between seat and valve; but after considerable service it is caused by a worn needle-valve, valve seat, or both. If not too badly deteriorated, the valve can be ground into its seat to make a gastight contact, provided valve and seat are accessible for manipulation. The mistake often made in such work is the use of emery or regular engine-valve grinding compound, which is altogether too coarse for such small valves. While such a compound may at first



Mr. Parker describes the art of grinding carburetor needle-valves. Strange to relate, a cleanser does the work best

produce a tight seat, flooding will soon start again, probably worse than before, and both valve and seat will be ruined.

Long experience in overhauling airplane carburetors, which receive extremely hard service, demonstrates that the most suitable material for grinding the valves is the cleaning compound known as "Bon-Ami," which may be bought for about ten cents a cake, and water (not oil). Other similar materials were found to be too coarse, though appearing at a casual examination to be about of the same grade. A handy grinding set consists of a tin or preferably a brass or copper box with a partition soldered in, forming two compartments: one just large enough to hold a cake of "Bon Ami" and the smaller one for water. It is not necessary to pulverize the cake; a little of it may be scraped up with the point of the needle-valve and a few drops of water applied.

The valve is ground in in the same manner as the larger valves on the engine, by turning back and forth and frequently lifting, adding more water and less compound as the grinding proceeds and valve and seat become smoothed.

Before grinding and before and after testing, both seat and valve should be thoroughly cleaned and dried—any compound remaining on them will interfere with the testing, and any gasoline remaining afterward will interfere with the proper action of the compound and water—in fact, grinding under the circumstances will be almost impossible.

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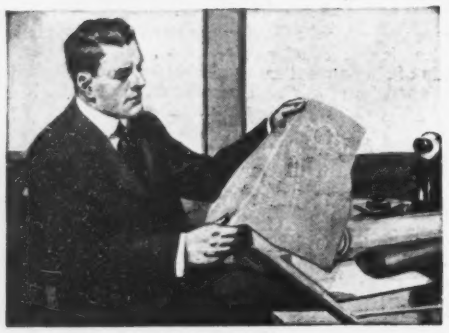

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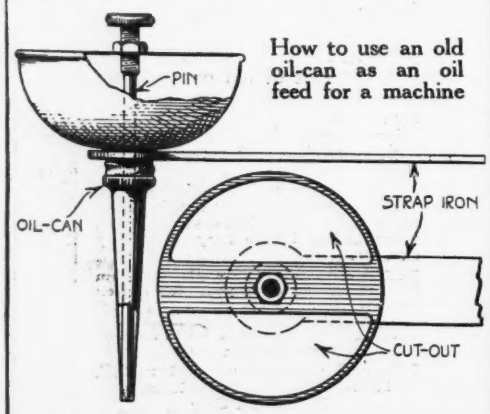
A cloth and a hardwood stick, *not* metal of any sort, can be used for the cleaning and drying, but if a compressed-air hose and small nozzle is handy, as would usually be the case around a garage, it is by far the best, as the seat is quickly cleaned and dried in one operation.

The method of holding the valve while grinding depends wholly upon the make and type of carburetor. If the stem projects, it may usually be ground in place; otherwise a special fixture is required. One is shown in the sketch, filed up from a strip of brass and bolted to a lug on the outside of the float chamber. A notch on the inner end of the bracket receives the stem of the needle-valve and care must be taken to center up the fixture before starting to grind. Some of the small short needle-valves either have a slot for a screwdriver, or one may be cut with a special narrow saw filed up from a thin steel spring; these are usually ground in place after removing the cap. In any event, the fixture, if required, must be designed to meet the special needs of each particular case.

In regard to the time needed for grinding, five to ten minutes should be sufficient; then test under a fair amount of pressure and if flooding still occurs, dry and grind again. It is well, at the same time, to give the carburetor a thorough overhauling; for, should there be any foreign matter inside the float-chamber, it will later cause trouble.

An Oil-Feeder for Machine Cutting-Tools

A SIMPLE but good oil-feeder can be made of an old oil-can as shown in the illustration. The sections are cut from the bottom of the can, leaving the strip, which is the width of a small nut. The nut is soldered to the center of the strip and



How to use an old oil-can as an oil feed for a machine

a pin threaded part way is screwed through the nut, the unthreaded part being filed to a size a trifle smaller in diameter than the threaded part. A piece of sheet iron is shaped as shown at X and slipped over the neck of the can, where it is held by the spout when the latter is in place. The can may then be attached to any part of the machine for use. Oil is poured into the can and the flow regulated by the pin.—W. H. UNDERWOOD.

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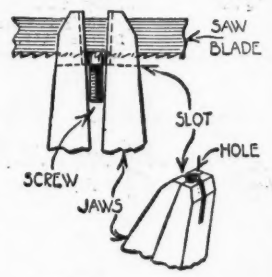
Adapting the Pliers for Slotting Screw-Heads

MECHANICS who work upon small machines or other mechanical appliances, such as clocks, phonographs or electrical apparatus, will find this idea of value. Where many screw-heads are to be slotted, some suitable means of holding them is necessary. To this end a pair of snub-nosed, parallel-jawed pliers can be quickly adapted.



Plier jaws sawed in this manner are doubly useful

Close the jaws and drill a small hole down between them in the center to a depth of almost ¼ in. Then saw a slot at right angles to the jaws, and to the same depth as the hole, and across the center of the hole.

Harden the jaws so they will withstand future sawing in the slot.

To use: Place the screw-head in the hole at the bottom. Close the jaws about it and hold the pliers against the bench.

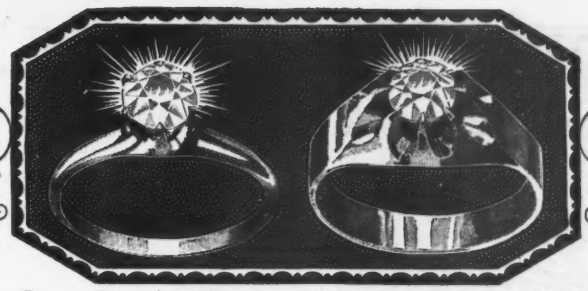
Then run the saw down the slot and cut the slot in the screw-head as deep as desired.—WINDSOR LOWELL.

Does the Spark-Lever Mean Anything to You?

NATURALLY a car operates at least expense per mile when it runs in high gear with the spark advanced, although sometimes this is not the case. When the car is running slowly this condition is a most extravagant one, first, because the spark is then too early producing a spark knock, and, second, because the power impulses are further apart and the action is therefore less even, power being consumed in overcoming the inertia of the fly-wheel, which is very great at an uneven torque.

Many drivers try to stay in high gear and keep their spark-levers advanced all the way as long as possible in climbing a hill. Under these conditions, when a change is finally to be made, it may be necessary to go down into low because of the low speed, whereas second would have sufficed with a little more momentum. Not only this, but there is a great strain on all parts and too much fuel is being wasted in this destructive effort.

Most drivers who do this think they are economizing, because they figure their engines are turning over less times the given distance of travel, and hence that less gas is being passed through the engine and burned. This is not so, for if a change were made to second speed, actually less fuel would be consumed.



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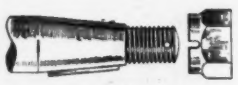
To Repair Your Battered Axle-Threads

THE threads on an automobile axle are often battered when removing a wheel. If the axle has a castellated nut—and nearly all of them have—the nut can be run on to the axle backwards—castellations first—which will recut the threads. The castellations act as a cleaner for the nut, which is then just as good as a die. This suggestion is especially useful for odd-sized axles.



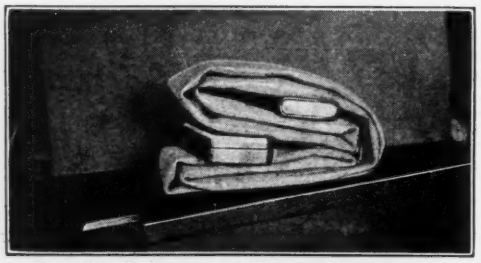
Running the nut backwards on the battered threads, the castellations make the threads as good as new

How To Fold Your Inner Tire Tubes

ALWAYS there is a right and a wrong way to do everything. This applies to the folding of an inner tube as well as pitching hay or regulating a watch. And yet so few automobile owners really know or care to know how to put away an innertube so that it will keep in the best condition for future use. The result is that the tube will perhaps crack around the valve, dirt will grind little invisible holes through the rubber or a twist will put such a strain on the whole structure of the tube that, if left alone for a length of time, it will crack almost as soon as blown up and put in use.

There is no particular art in folding a tube; it is only a matter of taking the time.

One of the best methods is illustrated in the accompanying photograph. The tube is deflated and laid out flat with the valve uppermost in the center. Then fold one end over toward the valve, then the other. Then bring these two folded sections together and secure in a solid bundle with a pair of heavy rubber bands made of narrow sections of inner tube. Put away in a cloth bag or in a box of suitable size and shape. This method keeps the valve inside and puts no strain upon it, and also insures instant accessibility in case it is wanted in a hurry.



Here is the way to fold your inner tubes so that they will not crack or puncture if left in the same po ition a long time

This method is not new, but is just a reminder for the man who likes to throw his tubes under the seat any old way so he can swear later when he finds them chafed and punctured through his own carelessness.

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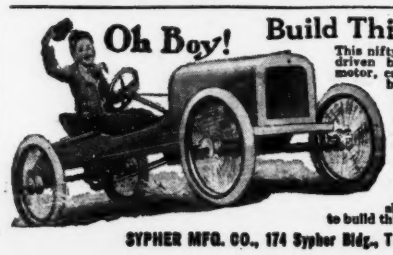

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Protecting the Open Automobile from Sudden Rain

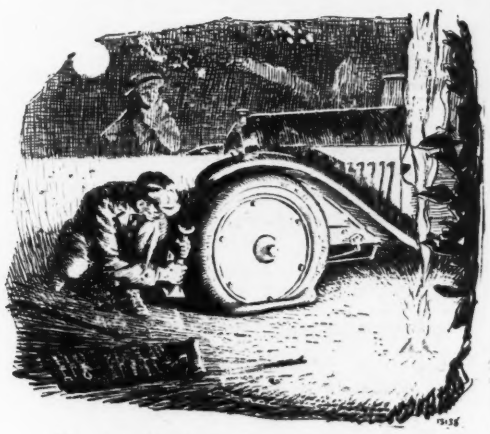
MANY automobilists prefer to keep their automobile tops down in summer, because of sudden rainstorms. How often do we see an open automobile parked beside the curb, the owner in his office, or store, or house, the seats so deluged by a sudden rainfall as to make it impossible to use except at the expense of wet clothing?

Here is how a man solved the problem in a simple way: A blanket is made of top material—either pyroxylin coated or rubberized. It need not be of as heavy material as the top. Making it consists merely of cutting the goods to desired size and hemming the edges. It can be folded and tucked out of the way when not in use. Goods are obtainable from top-makers, trimmers, and department-stores.

If there appears to be danger of rain, the automobilist spreads the blanket over his car, while leaving it to enter a building. This saves the time and bother of putting up the top.

It's the Little Things that Count in Automobiling

ONE of the best methods for keeping the cylinder walls free from carbon is to treat the inside of the cylinders with a mixture of alcohol and kerosene in the proportion of one to three. This must be done when the automobile has come in from a run and the



If a trouble lamp is not at hand, pour some gasoline on to some sand. This will give enough light to make the repairs

engine is hot. One third of a drinking-glass full of this mixture should be injected in the compression cocks of the engine when it is silent and allowed to remain overnight. Next morning the engine should be allowed to idle, and, after it has warmed up, the petcocks opened one at a time to assist in blowing out the particles of carbon.

If this is done regularly once a week or every four hundred miles, the cylinder walls will be reasonably free from carbon and the engine will deliver its maximum power.

If you open the relief valves to look for a cylinder missing explosions, and fail to see a flame, do not condemn

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You will gain in vim, and vigor; your muscular power will increase in flexibility and strength, your nervous system fortified to renew its energy, not bolstered up for the time being, to fall back below the level it was, as it does when you resort to drugs or medicine.

You married men come across to yourself—get the pep and ginger and tingle of life into you. You are not living for yourself alone; you need dash, spirit, the enterprise you used to have. Regain and maintain your vigor; I'll show you how.

You business men—overworked, did you say? You are not doing half as much as you ought with your experience. Never mind, there is a way to get back your aggressiveness, to be right in the fight and enjoy it. You can double your percentage of real worth as a man, and enjoy life as you ought to be able to do.

You young men—think of your future—how about it—are you fit for marriage—are you qualified—do you feel it in your soul—are others sliding by you doing more—getting more than you are? I know what is dragging you down, what is keeping you down, and it is time, high time, that you **Stop.** No one can abuse nature and succeed; others tried it and failed miserably. Do you want to be a failure, or even worse than a failure? Then come to me; I have helped thousands; physically, mentally, morally. I will help you; I will make you the kind of young man that is a credit to any community—will make you so that your progress in any undertaking will be easier. Just be frank and above board—tell me your troubles. I will guide, direct and point the way; the natural way for you to achieve what I have said—Nature's way. You can stop the drain on your system, you can be free from bad habit, gain muscular tissue, be strong, virile, erect in carriage, courageous and likeable to all you meet. Let me be your guide, your teacher. I have pupils all over the world, learning a system of Health, Strength, moral courage building, known as

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Popular Science Monthly

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that cylinder. Open the throttle and give it enough gas to fire. When the throttle is closed and the relief valve open, the engine sucks in so much fresh air that some cylinders cannot fire.

If your engine is slow to warm up and the hot-air intake does not leak, give it a richer mixture by means of the choke-valve. But do not do this too long as raw gasoline will be drawn into the cylinders and may result in carbonizing badly.

Many times a motorist is caught on the road at night with tire trouble and finds himself without a trouble-light. In this difficult situation scrape up a small pile of sand. Pour about a cup of gasoline on it, and touch a match to it. This will burn fifteen or twenty minutes and will provide sufficient light to make the repair.

Sharpen Your Knife on the Family Scissors

NEXT time your pocket-knife needs sharpening and you can't find anything to whet it on, try the scissors.

Whet the edge of the knife on the

Whetting pocket-knife on the edge of a scissors blade gives a keen cutting edge

sharp edge of the scissors blade opposite the cutting edge, and you will probably be surprised at the result. This will not always work well if the knife is very dull, but for ordinary work it is a good and a quick way to get a keen edge.

A Stencil-Holder for Marking Merchandise Barrels

IF a great many barrels have to be stenciled, the task becomes a weary one. A method of applying the stencil rapidly and of lightening the labor is herein shown and will repay the user for the trouble of making it.

Erect a solid post in a position where the barrels can be quickly rolled and handled. Then take a piece of leather or canvas belting somewhat longer than the circumference of the barrels and rivet one end to the metal stencil.

The opposite end should be riveted around a square ring of stiff metal

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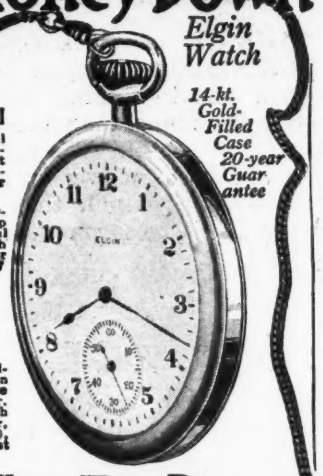

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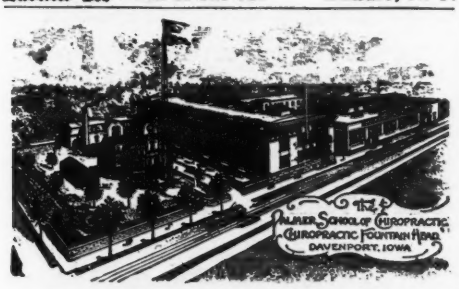

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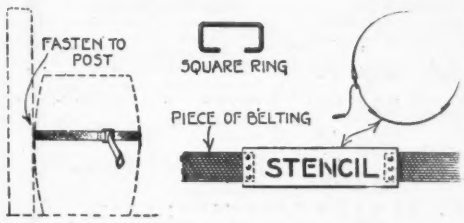
rod, larger than the width of the belt.

Then rivet a second shorter piece of belt to the other end of the stencil. Pass it through the square ring on the first piece of belt and fasten a handle of stiff metal to the free end. Fasten



The stencil belt is pulled tight around the barrel and the paint is applied over it

the longer belt to the post as high as the point at which the barrels are to be stenciled.

Set the barrel against the post, loop the belt over it and draw the strap tight.

This will pull the stencil tightly against the barrel. The strap can be held with the left hand and the stencil-brush applied with the right. This will mean much saving of time where many barrels are to be handled.

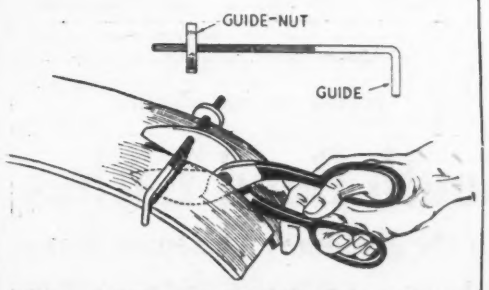
A Belt-Cutting Device on Tinners' Shears

WHEN it is desired to cut belting or strips of similar material, the difficulty lies in keeping the strip of uniform width. With the attached device on a pair of common tinner's shears as a guide, the job can be done easily.

Drill a small hole near the top edge of the uppermost blade. Tap this hole and then provide a steel rod, threaded for a tight fit and long enough to include any width of belting you will cut. Bend one end of the rod at right angles to act as the first guide.

Thread the rod in the hole in the shears about halfway through. Then run a tight fitting, wide nut on the opposite end to act as a second guide. The assembled affair is shown in the sketch.

The distance of the cut from either side is determined and then the rod



The scissors cannot help but cut a straight line because the guide directs them

and nut are adjusted so the blades will cut at that point and each guide bear on its own side of the stock. This keeps the shears from deviating from the intended line and insures a straight cut.

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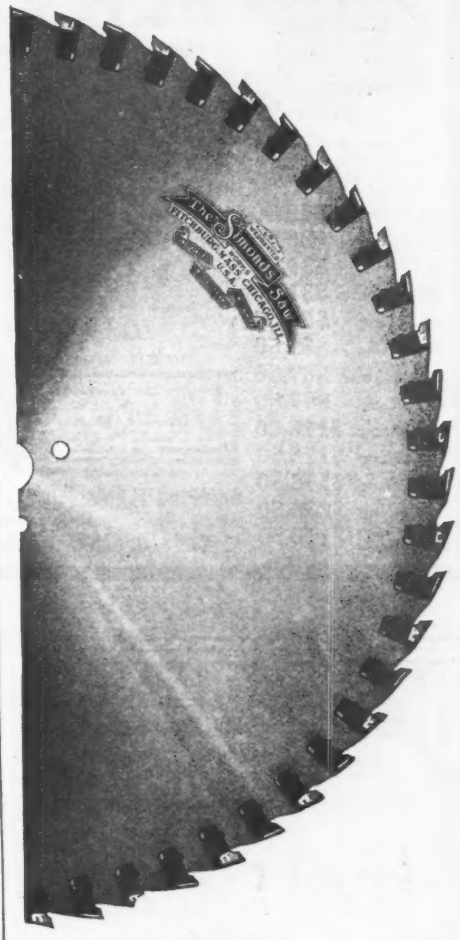

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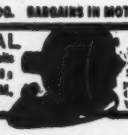

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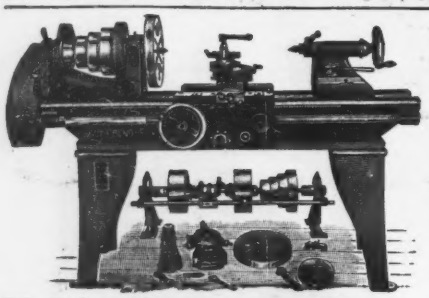

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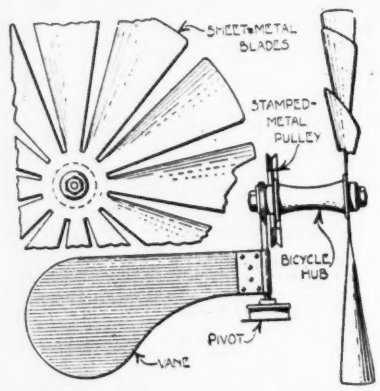
To Make a Windmill from a Bicycle-Hub

THE efficiency of a small windmill depends largely upon the bearings. For a small windmill there is no better beginning than the hub of an old bicycle wheel. The hub from the rear wheel will answer for a considerably larger windmill than the front hub. The vanes can be cut from a

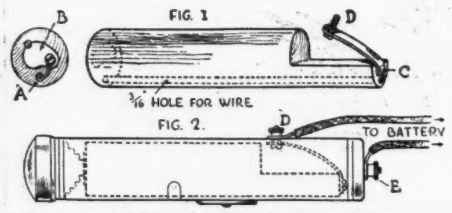


A bicycle hub makes the best kind of a foundation on which to build an efficient windmill

single disk of galvanized iron and bent to the proper angle, and a hole cut in the center so that the disk will lie against one of the hub flanges, to which it can be riveted. Or, if desired, the vanes may be made separately and riveted to the flange. The other flange serves as a support for a stamped steel pulley. If necessary, the holes may be enlarged to take screws for fastening a wooden pulley. One end of the threaded axle is fastened, by means of the nut and a lock-nut, to the supporting frame, and it should be added that it is necessary to use a good deal of care with the fastenings, for in a windmill of this type that was built last summer there was a rather surprising tendency for the nuts to work loose.

Connecting Dry Batteries to a Flashlight

BY connecting several ordinary dry cells to a flashlight, it may be used for long periods without the expense and short life common to the standard flashlight battery. This



A round stick cut in the manner shown connects a dry battery to any ordinary flashlight

makes it a good bicycle or carriage light, and it may also be used in place of a miniature lamp on a battery-lighting system.

For a two-cell flashlight, obtain a round stick 1⅜ in. in diameter and 4 in. long. Measure 1½ in. from one end and ¾ in. down from the side, and

Your Machine's Value Depends—

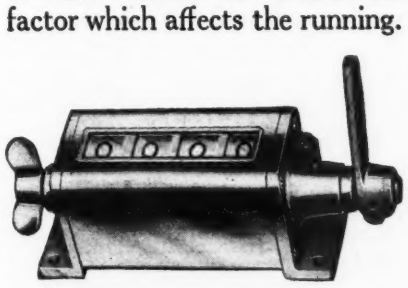
Your machine's value may vary with the skill of its operator, the manner of its adjustment, the condition of its repair; its *capacity* may never be realized.

But records of its *production*, made as the machine works, will show its prowess as a producer and prove what right handling will do.

The machine's full value is utilized *only* with a

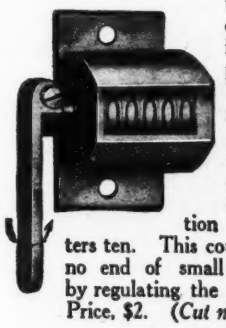
Veeder
COUNTER

attached to register the results of each human or mechanical factor which affects the running.



The above Revolution Set-Back Counter records the output of any machine where a shaft revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $10.00 (subject to discount). *Cut less than one half size.*

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required in recording the output of punch presses. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adapted to no end of small machines, simply by regulating the throw of the lever. Price, $2. (*Cut nearly full size.*)



Other models of counters are shown in the Veeder booklet—one suitable for every machine. Write for free copy.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn

take out a block. Then place in a vise and drill a 3/16-in. hole lengthwise ¾ in. from the edge of the block, beginning at *A*, Fig. 1. Cut out a piece of brass of the shape shown at *B*, and attach to the end of the block. No. 18 insulated wire is run from the screw, in *B*, through the block lengthwise and connected at *C*. At *C* there is a strip of copper ⅜-in. wide and 1¾ in. long. One end is drilled for screw, *C*, the other has a connecting post, *D*. Drill a hole through the flashlight case for *D* to come through, as in Fig. 2; also put a post on the screw cap, at *E*, Fig. 2.

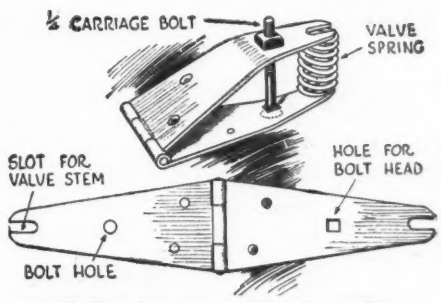
When the block is slipped into the flashlight the contact *B*, touches the base of the bulb. Be sure to place a cardboard disk between the screw cap, at *E*, and the block, in order to prevent a short circuit through *C*.

The batteries are put on at *D* and *E*, Fig. 2, and the current goes through the copper strip from *D*, lengthwise of the block through the wire. It gets to the lamp through contact *B*, Fig. 1, and back to *E*, through the switch.

When you wish to use a flashlight battery, the block can be removed by pushing *D* down through the hole.

A Valve-Spring Compressing Tool You Can Make

ONE can buy millions of accessories and tools made for various purposes by inventors who have nothing else to do but sit and plan intricate arrangements for simple things. The



This valve compressor is made from a hinge and spring and is fully the equal of the kind you buy in the hardware stores

writer has tried many different kinds of valve-spring compressing tools, but not until he used his own brains was he satisfied that the problem of compressing springs had been solved.

Any one with a drill and a hacksaw can make a spring compressor in ten minutes, a device that is guaranteed to be the best tool made for the purpose.

Materials required are an old door hinge and a ¼-in. carriage bolt. Cut a slot in the end of the hinge, just large enough to slip over the valve stem. Cut holes in the hinge for the carriage bolt and the thing is done. Slip the two leaves of the hinge over the spring; turn down on the nut and the spring is compressed. The spring may be left in the compressor until it is to be replaced.

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THE economical production of Drop-Forgings requires the use of many modern labor-saving devices and efficient means of shop transportation must be provided for heavy, bulky pieces like crankshafts, axles, etc.

In Williams' Works, steel is unloaded from the cars and carried to the shears by travelings cranes. Thence, until the forgings reach the shippings platforms they are moved by electric lift-trucks, or "jitneys." By placing the forgings on suitable platforms as they pass thru each operation, they can be picked up and delivered by the jitneys without further handling.

The efficiency and economy of this simple system are typical of Williams' methods in the manufacture of superior Drop-Forgings and Drop-Forged Tools.

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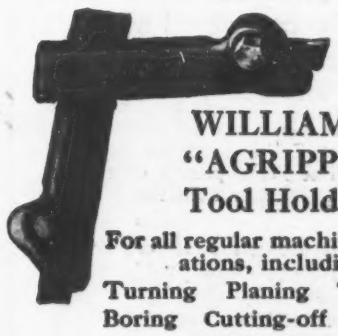

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And Red Devil Tools are distinctly quality tools. In each instance the best material is used for its purpose. The little points of design receive particular attention.

Red Devil Tools are Handy and Reliable

BOOKLET ON REQUEST

SMITH & HEMENWAY CO., Inc.
264 Broadway, New York.
Factories: Irvington, N. J.

Garage Repair-Tags Are Handy Things

WHEN a car goes into the repair shop, it is tagged. After the job is finished, the tag goes to the bookkeeper and is used for itemizing the bill to the owner.

The bookkeeper is usually a dainty damsel who doesn't like to soil her pretty pink fingers by handling greasy job-tags.

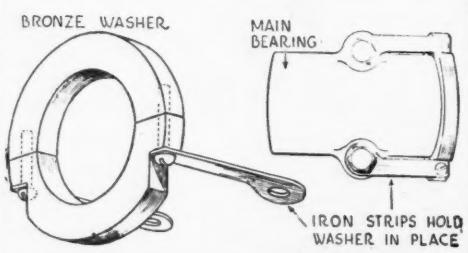
It really isn't necessary that she should. A tag-holder is the thing now in up-to-date garages. A piece of leather cloth or leather substitute is cut the required shape and size. A piece of transparent sheeting (same material as is used in the window lights of the car) is then cut about a quarter inch smaller all around. The edges of the back, which may be a piece of top material, are lapped over the bottom and sides and sewed down. The top is left open to allow the tag to be slipped under the sheeting.

The holder is washable, since both back and face are waterproof. Of course the holder can be used over and over again. No more greasy fingers for the garage bookkeeper.

A Way to Remove End Play in a Crankshaft

IT is not always practical for one to replace the main bearings or the caps in an engine which is giving no trouble except for a slight end play in the crankshaft.

Although any end play in this member is destructive to both the engine and the transmission, it seems a pity to spend time in fitting new bearing caps, and so the following suggestion is given to obviate the trouble:



End play in an automobile crankshaft can be prevented by placing a bronze washer over the crankshaft between the bearing and flywheel

Measure the clearance between the last or rear bearing and the flange on the end of the crankshaft, and dress off the end of this last bearing until approximately ¼-in. play or clearance at this point is obtained. Next fit a bronze washer so that it will compensate for this clearance and have a hole in it ⅛ in. larger than the shaft. Cut the washer into two pieces with a hacksaw, then fit two machine screws to hold the two parts together. This split washer may then be placed over the crankshaft between the bearing and the flywheel

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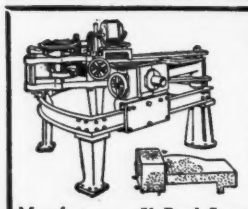

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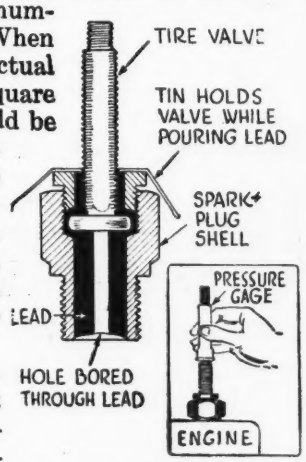
flange, and will compensate for end play.

Upon referring to the illustration, one will note that where the retaining screws pass through the halves of the washer, the lower part has been filed flat. This is to permit the fitting of a flat piece of iron between the head of the screw and the washer. This latter piece of iron should be clamped beneath the head of the bearing-cap retaining-bolt and will prevent the washer from rattling.

Compression Testing with a Homemade Tool

IF you were to ask your automobilist friend how much compression he had in his engine, he might remark: "Well, the compression is pretty good in cylinder number one; not so good in number two; poor in number three; and medium in number four." When it comes to actual pounds per square inch, he would be entirely at sea; yet the actual pressure in pounds is an important thing to know.



This old spark-plug compression tester tells you the condition of your engine

It is essential that the compression be practically the same in all the cylinders; if the compression is unbalanced, the engine vibrates, knocks, and gives an uneven flow of power. An unbalanced engine is often the cause for much trouble and discomfort, yet the owner seldom realizes this. He feels that he can guess at the compression by turning the hard crank, yet his guess is worthless unless the compression is absolutely "rotten," to use a slang expression.

Before you drive another hundred miles, go into your garage and make the little device illustrated—a compression tester; use it regularly, and if the compression in your engine falls below 60 pounds, it is time for you to make repairs.

Remove the porcelain from an old spark-plug and put back the gasket-retaining bushing, but omit the gaskets. Remove the inside from an old tire valve and cut a hole in a flat piece of tin, just large enough to receive the head of the valve. Push the valve through the tin, place the whole on a flat pile of sand, or on a concrete floor, and over the stem of the valve place the shell from the spark-plug. Then pour in some melted lead until the valve stem and the spark-plug are firmly held together. At any time you may screw an air-pressure gage into the device and put the plug into the cylinder. The compression will be shown in pounds to the square inch.

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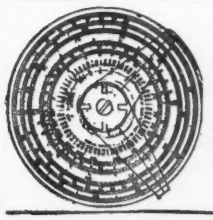

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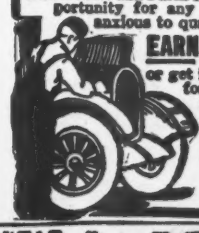

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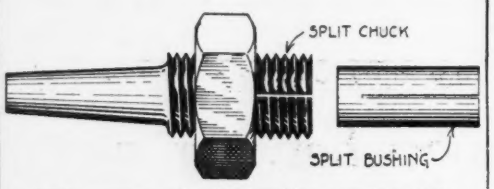
Here's a Split-Chuck Wrinkle that Is New

MAKING a split-chuck from a bolt is an old and well known affair, and is very useful. But it will hold only one size of drill or rod. To make one that will hold a number of sizes, make the hole as large as the bolt will permit; also make a number of bushings of tubing, all of the same outside diameter, but of different thicknesses, splitting the bushings as the chuck is split. Thin tubing of various outside diameters can be used to make concentric bushings, so that various odd sizes can be made up.



This system of split bushings enables the split-chuck to hold various sizes of wire and drills without having to buy extra chucks

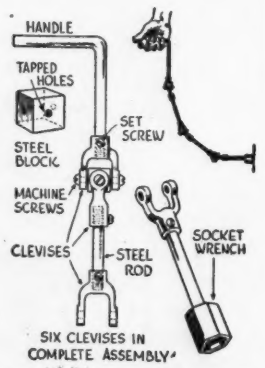
A Flexible Wrench Made of Clevis Rods

A FLEXIBLE wrench for light work can be made by utilizing several automobile clevis rods assembled in the form of universal joints. This can be done by any amateur mechanic and at little expense. Such a wrench can be used to work around obscure places in replacing and removing nuts, etc., which cannot be reached easily with the ordinary wrench.

The connectors for the clevises are square steel blocks with drilled and tapped holes in four opposite sides as shown. They should fit loosely between the tines of the clevis and in such a way that the two clevises are situated at right angles to each other. Thus, each clevis will have opportunity to swing in a considerable arc in its own direction.

Each universal joint thus made is connected to the next one by a short piece of rod connecting the two nearest clevises. Three universal joints are used in the wrench and a socket wrench attached to the last clevis. The rod attached to the clevis at the opposite end of the chain is bent at right angles to furnish a handle.

Connections from clevis tines to the blocks are made by machine screws passing loosely through the holes in the tines and threading solidly into the tapped holes in the blocks.



How automobile clevis rods make flexible wrenches

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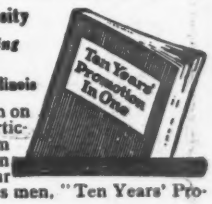

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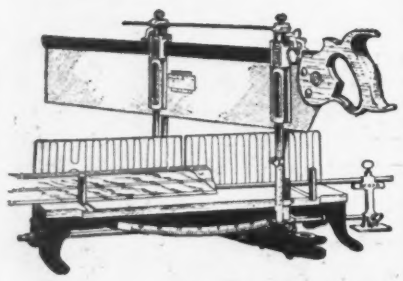

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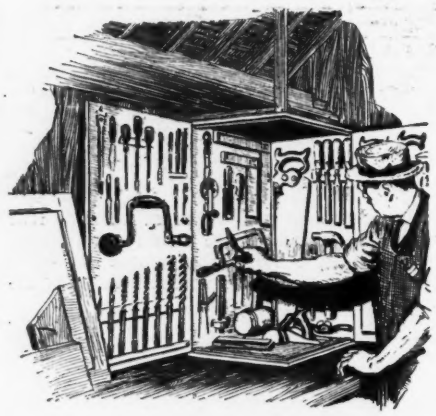
Saving Shop Space with a Tool-Cabinet

IN a shop where space is at a premium a corner tool-cabinet is a great thing and is easily constructed. The dimensions and proportions may be anything desired. The idea is simply to put a rectangular cabinet in the corner and make the two exposed



A tool-cabinet in the corner saves space and makes tools easy to reach, for they all have a certain place in the cabinet

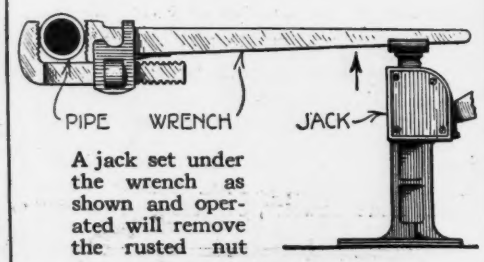
sides open outward as doors. A single lock secures both when closed.

The doors open against the walls and not only give a lot of space for hanging tools, but when opened expose the whole layout, making it easy to reach any tool that the cabinet contains.

Turning Rusted Threads with a Jack

WHEN piping or other threaded metal has been set up for a long time, it is oftentimes impossible to start a member with even a large-sized pipe-wrench. Even the addition of a length of pipe to the handle of the wrench to gain greater leverage will not start the threads. A simple trick, which will do it if anything will, is shown herewith.

Arrange the wrench in such a position that the space between the end of its handle and some solid foundation will just accommodate an auto-



A jack set under the wrench as shown and operated will remove the rusted nut

mobile jack. Set the jack in place, pump several times on the handle and something will be sure to start; either the threads or the wrench.

This is an idea that may prove valuable some time in a case of emergency.

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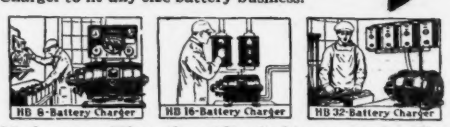

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